Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "THE ELECTRICAL ENGINEER."

VOL. XXXIV. NEW YORK, SATURDAY, SEPTEMBER 9, 1899. No. 11.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

CHICAGO OFFICE, - - - - - - - - Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - 929 Chestnut Street.

T. C. MARTIN AND W. D. WEAVER, - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - Associate Editor.
CARL HERING, - - - - - - - - - Special Contributor.

J. M. WAKEMAN, - - - - - President and General Manager.
T. C. MARTIN, - - - - - - - - - - Vice-President.
A. C. SHAW, - - - - - - - - - - - - Secretary.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico . . . . . per year, $3.00
Foreign Countries within the Postal Union, ... 6.00
Single Copies, ...10
In requesting your address changed give OLD as well as new address.

(Entered as second-class mail matter at the New York Post Office.)

NEW YORK, SATURDAY, SEPTEMBER 9, 1899.

CONTENTS. PAGE.

Editorial 369
Eigthteenth Annual Meeting of the American Street Railway Association... 372
Patents and Trade Mark Reform..... 372
Meeting of the New York State Electrical Contractors..... 372
Fourth Annual Convention of Municipal Electricians..... 372
Gasoline Engine, 60-kw, 220 Volt, Watertown, S. D., Central Station, by Prof. F. W. Springer 373
The Economy Effected by the Use of the Electric Motor Around Steel Plants, Furnaces and Foundries, by Andrew E. Maccoun..... 374
A New Method of Determining Ratio of Transformation, by J. R. Bibbins. 376
The Storage Battery in Telephone Exchanges..... 377
New Telephone Exchange and Multiple Switchboard Patents..... 378
The Field of Experimental Research, by Elihu Thomson..... 379
A Magnet Phenomenon, by A. H. Ford and B. Frankenfeld..... 382
Direct-Alternating Generators, by Alton D. Adams..... 383
Current News and Notes..... 384
LETTERS TO THE EDITORS:
Electricity Direct from Carbon, by F. Hardie Jeannin..... 386
A New Type of Motor and Unipolar Dynamo, by James Asher..... 386
Digest of Current Electrical Literature, Compiled by Carl Hering..... 387
NEW BOOKS:
The Life Story of Sir Charles T. Bright, C. E..... 391
Tests of Small Current Meters..... 392
Vacuum Telephone Transmitter, by P. Kilduchevsky..... 393
Power in a Modern Factory in Chicago 393
Electrical Engineering at Drexel Institute 393
NEWS OF THE WEEK..... 394

DETROIT LIGHTING.

The Public Lighting Commission of Detroit, Mich., whose previous reports have been so interesting and provocative of discussion has just issued another report for 1898-9, which says that "the mere money cost of an arc light is not a satisfactory standard by which it may be absolutely determined." We have read the report carefully but must confess that all we can make out of it is that mainly by cutting down wages and figuring depreciation at the men daciously modest minimum of 3 per cent. the approximate cost of an arc to the city from its own plant is $75.56 per annum. Mr. Samuel Insull and ourselves, taking last year's figures, made it anywhere from $25 to $40 more, but, of course, that is another calculation. Next year the cost—but after all that is a matter of indifference—ought to be less than $75, as the plant needs more money. "We respectfully ask that an appropriation be made of $108,850 for the operation and maintenance of the present plant and of $51,150 for the improvements, the extensions and the operation of the extensions, making a total of $160,000." It may be noted incidentally that at Atlanta, Ga., where a municipal plant was recently proposed, by those who had the example of Detroit to urge, the arbitrators chosen showed that the local company was doing better by the city than a municipal plant could do for it.

As the convention being held this week at Wilmington shows, a new body of men, the municipal electricians, are beginning to emerge from the limited fire alarm and police telegraph fields. There are good men among them, and the new duties will require a higher standard of qualification of them than ever. We are sure that as they come to deal with the lighting and power questions they will be glad to work in closer harmony with those operating such plants, and that we shall hence see less of the effort that has been made to prove private corporations mere highway robbers. It is eminently desirable that there should be fuller and clearer understanding of the work, on both sides; and such conventions should help materially in the improvement of all municipal electrical conditions.

WASTED EFFORT.

In another column we print a communication on the subject of that ignus fatuus of a certain class of inventors—the unipolar dynamo. In this instance, the inventor takes the privilege of also inventing a definition to suit his purposes, and defines a unipolar dynamo, not in direct terms of the magnetic factor, but as a machine "in no part of which is the current of electricity periodically reversed." The machine would generate an e. m. f. if the copper cylinder were given motion concentric with the pole of the permanent magnet; and instead of being a new type, it is nothing else than Faraday's tube dynamo, which was described soon after his discovery of electromagnetic induction. It is doubtful, however, if the machine would be operative if the magnet were revolved and the tube remained stationary, as in that case, the lines of force would not only cut the cylinder, but also the conducting leads therefrom, thus setting up two equal and opposing e. m. fs. However this may be—and the

problem is scarcely worth discussing—what advantage would accrue from this method over others now in commercial use for transforming mechanical into electrical energy? The claim of a mechanical advantage in the substitution of mercury contacts for rubbing contacts is, of course, absurd. And the principle of a stationary field coil does not require a new-fangled machine for its application, such a coil being used, for example, in the inductor alternator.

The effort which has been wasted on unipolar dynamos appears to be due to a misunderstanding of the principle of machines in general, and to an ignorance of the principles of operation of electrical machines in particular. Recently we referred to the case of the rotary engine, which is, in a sense, a parallel one to that of the unipolar dynamo. In both cases sight is lost of the fact that the desideratum of an energy-transforming machine is solely to effect the transformation of energy of one kind into energy of another kind, with the highest possible efficiency, coupled with the lowest cost in investment and operation. We are not aware that any one has ever asserted that a unipolar dynamo could exceed in efficiency other types of electric machines; and even if this claim were made and proved, it would have little commercial bearing, as the margin remaining for increase of efficiency in transformation in electrical machinery is extremely small. Nor are we aware that any claim has been made that a unipolar dynamo could be constructed more cheaply than one of corresponding capacity of another type, or that it would be cheaper to operate. Consequently, there does not appear to be a single commercial reason for the time and money which have been spent in an endeavor to invent a unipolar dynamo.

Were the principles upon which the action of electrical generating machinery rests better understood, the unipolar dynamo would lose its charms to the would-be inventor. For, if he realized that the generation of electromotive force depends merely upon the cutting of lines of force by a conductor moving in a magnetic field, and that the number of such lines of force that can be generated for a given number of ampere-turns depends only upon the geometry and the material of the magnetic circuit, he would know that, so far from there being any virtue in the unipolar principle, it is intrinsically opposed to efficency in design. The misdirection of the energy of the inventor is not, however, confined especially to this field, though it is there perhaps most hopelessly wasted, since there is little likelihood of any indirect benefit being obtained from failure. Those who have occasion to examine currently the budget of thirty or more electrical patents issued weekly, cannot but be impressed by the vast expenditure of time, money and thought on inventions which it is easily seen have no possibility of commercial success. Of ingenuity there is aplenty, and much of it to be admired. But mere ingenuity embodied in an invention which, from its complication, cost of production or lack of appreciation, has no chance of success, involves a waste of effort which, usually being that of intelligent men, results in a loss to society in general, as well as to the individual.

ELECTRIC CABS.

We have been under the impression that electric cabs have already demonstrated their right to exist and are an admitted success. It is, therefore, rather surprising to us to find this item on the editorial pages of *The Horseless Age* of this city: "The withdrawal of the London electric cabs, the change of the Paris electric cabs from 'fiacres' to 'voitures de grande remise,' for which higher rates of fare are charged, the well-authenticated reports that the New York Electric Cab Company is looking anxiously for some economical motive power, all go to prove what might have been known without the waste of so much money—that in the present state of the storage battery art, electricity cannot compete with horses in public cab service, but is of necessity confined to luxurious use." This strikes us as an extraordinary jumble of inaccuracy and misinformation. Better things and truer things are expected of our esteemed contemporary.

So far as we can ascertain, the electric cabs in London, as a service, have suffered chiefly because their drivers, as soon as trained, have been drafted off, under inducement of higher wage, into private employ. There may be something wrong with the modeling of the cabs, but certainly the batteries are all right. In Paris, as in New York, the electric cab service is suffering because there is such an enormous demand for the vehicles; they are always engaged ahead, and hence are not available as fiacres. We have been in the electric cab stables in this city on some days at ten in the morning and have seen orders and applications for several times as many cabs, hansoms and coupés as the company had, all for the same night. As to the statement that the Electric Vehicle Company is looking for a new motive power, it is a gross untruth. It has to-day about 3000 electric cabs and hansoms ordered, and as soon as they can be built they will be put in service in New York and other cities. At the same time, we believe it to be the fact that there is room for a good hydro-carbon vehicle for certain classes of work and that when it is found it may be built at the Columbia works in Hartford. To our own personal knowledge the quest for such a practical gasoline, petroleum, naptha or kindred vehicle has been carried on by the Columbia people for some two or three years past, and no such feasible type has yet appeared above the horizon that will satisfy the American standard in any degree. If *The Horseless Age* has evidence to the contrary now is the time to produce it.

The electric automobile is here and here to stay and improve. No half truths can wipe it out. It is winning its way against other types just as the trolley won its way against the horse, the cable car, the compressed air car, the gas car, the steam car and a host of other types. It is still crude, but it is rapidly improving, and the work of such men as Riker, Sperry, Woods, Maxim, Condict and others in this country is doing what the work of Sprague, Henry, Van Depoele, Daft and Field did for the trolley. Five years hence the criticism of *The Horseless Age* will sound just as do some of the criticisms of ten years ago on electric traction. If other motive powers are superior why don't they come along?

There is no need for us to confess our predilection. It is writ large on our title page. But there are disinterested and contra-interested people who think as we do. Mrs. Davis, a lady who started out to cross the Continent in a hydro-carbon vehicle that failed too frequently for mention, said on arriving and stopping definitely in Chicago that she could well understand the preference of the average woman for an electric carriage. So, too, with amateurs, nearly all of whom display an unmistakable affection for the electric, despite its present high price. We are glad to note that in an interesting article in the September number of the *North American Review,* the Marquis de Chasseloup-Laubat, an enthusiastic electric automobilist in France, presents what he considers to be the advantages and disadvantages of the several types of automobiles. The steam automobile requires, he says, about 25 pounds per hp-hour of its total weight for supplies per hp-hour; needs a mechanic as fireman independently of the conductor, and its maintenance is quite complicated and difficult. Its advantages are relative inexpensiveness, steady power, good starting torque and ability to climb grades readily. It seems designed, therefore, for heavy traffic, for running across broken country or for lengthy trips where there is no certainty as to provision for supply. The electric car-

riage is pronounced par excellence the type for urban service, but for passenger rather than for freight traffic. It is better adapted than the steam carriage for quick movement and for grades, and works without noise or vibration. The 45 to 65 pounds of storage battery weight required per hp-hour and the length of time for recharging the batteries necessarily limits its sphere of action. The petroleum carriage requires but 1.65 pounds of supplies per hp-hour, and is hardy and relatively simple and readily run. Its vibration, however, though somewhat diminished in the latest types, is still quite perceptible. The combustion of the oil produces a disagreeable odor, if carburization is not thoroughly regulated. The danger of fire from the fuel carried is always to be feared. The motors hitherto built are not lasting and are somewhat feeble in starting and on an up-grade. It is nevertheless pronounced a good carriage for service in both city and country combined, while for long runs it is at present the only one available.

Here we have a fair presentation of the status quo. Our own belief is that the requirements as to long runs are overstated and that even for heavy work in cities, the electric automobile will yet prove its superiority. But let everybody have patience and some regard for truth while the facts and data are being out-threshed.

THE FIELD OF EXPERIMENTAL RESEARCH.

Prof. Elihu Thomson's address before Section "B" of the American Association for the Advancement of Science, which is printed in this issue, is in many ways interesting reading. Prof. Thomson is always essentially practical, and represents that class of utilitarians in science who have done so much to improve our knowledge and power during the past half century, and who seem destined to effect enormous sociological improvements during the coming century.

A number of experimental suggestions are offered, one of the most interesting of which is for the production of a steady stream of high-frequency oscillations from a continuous-current circuit; or, in other words, for a very high frequency alternating-current generator. There can be no doubt that a source of very high-frequency electric waves is greatly desired at the present time. The highest electric lighting frequency is about 140. The highest frequency in ordinary experimental physics outside of telephonic currents is about 1000. Condenser discharges, it is true, run up into frequencies of many millions, but they are mere isolated discharges consisting of groups of a few diminishing waves separated by relatively long intervals of rest, and differ from what is required in the same way that the twang of a harp-string differs from a sustained organ note. The sustained excitation of a powerful Hertz oscillator would require hundreds of horse-power, although the total stock of energy which the apparatus radiates during each discharge, in existing practice, at this rate is only a few joules. We have the power available in the steam engine, and we have an oscillator of enormous frequency, but we have no means of connecting the two so that the power shall be released in this form. The plan suggested is a high-frequency condenser and induction coil charged by direct-current mains through a choking coil. We are inclined to think, however, that experiments in this direction have shown a difficulty in maintaining the high-frequency oscillations, and that some further improvement is needed before the apparatus can be relied upon to operate continuously.

The principal theme of the address is, however, on the limitations which past discoveries continually impose upon the future range of experimental inquiry. There can be no doubt that the more knowledge we obtain the more closely we limit the range of experimental research to the highways of established truth. Moreover, the limitations of pressure, temperature and space necessarily become more clearly apparent year by year, just as the address describes. But on the other hand, the limitations of mechanical accuracy and mechanical applications have always hitherto expanded in conformity with the expansion of physical knowledge and requirements. One hundred years ago, the experimentalist had more limited knowledge of physics and a limited choice of mechanical apparatus with which to test his theories. At the present time, the experimentalist knows much more definitely what to expect, but has far better mechanical apparatus at hand with which to pursue his inquiries. For example, the Zeeman effect of the influence of magnetism on the spectrum seems to have been expected and sought for by Faraday, but could not possibly have been discovered with the apparatus constructed in Faraday's time. In the same way we cannot but believe that there are numerous phenomena in nature of great importance to a proper understanding of her, and which the relative crudeness of our apparatus renders undiscoverable at present. We think, therefore, that while admitting the truth of Prof. Thomson's views concerning the greater skill, accuracy and equipment demanded for physical research by each succeeding decade, that there is no fear whatever of advance being retarded by these limitations. On the contrary it would seem that the advance in physical knowledge and in the applications proceeding therefrom, should increase in geometrical ratio. The work may have to be systematized on account of its increasing extent and will no doubt require more extensive endowment and ever-increasing skill, but there will be more numerous workers, greater returns, greater investment in research and greater co-operation. There is every reason to expect an abundant harvest.

One direction of physical research not mentioned by Prof. Thomson is capable of yielding valuable results for a long period, without further extension of experimental means; namely, the correlation and unification of the various departments of physics. After the different observers have recorded the results of their labors, there is always room for those who seek to connect and correlate the various results. Without such work, science would become forever and ever more complex, whereas, in fact, science becomes forever more simple although more extended. Nature is essentially one and the same, and when we class one set of phenomena as electrical, another as magnetic, and a third as mechanical, we merely confess in a certain sense the limitations of our knowledge and perceptions. Even now, the divisions separating optics, electricity and magnetism are fast disappearing, and in the distant future we may expect that there will be no dividing lines left between any branches of natural philosophy.

Another suggestion thrown out by the address is to the effect that possibly the ether may be devoid of those mechanical properties which we recognize in matter and possess only electromagnetic properties. We cannot help opining that this is a very hopeful possibility. We do not believe that there is any experimental evidence yet obtained which calls for the belief that ether possesses inertia or momentum in a mechanical sense of those terms. On the contrary we are inclined to think that the inertia and momentum of matter are electromagnetic properties due to the connection of matter with ether, and that ether itself need not be fettered by any such restrictions. The moment we impute inertia to ether we indorse Lord Kelvin's results as to its enormous tenuity and enormous elasticity on the basis of a jelly-like material medium, and these results, while not necessarily impossible, are almost inconceivable. Once we release ether from inertia, the enormous speed with which it transmits disturbances becomes interpretable by electrical methods, as distinguished from mechanical methods.

Eighteenth Annual Meeting of the American Street Railway Association.

The eighteenth annual meeting of the American Street Railway Association will be held at "Tattersalls," State and 16th Street, Chicago, Ill., Oct. 17, 18, 19, 20, 1899. Papers will be read on the following subjects: "Maintenance of Car Equipment," "Modern Street Railway Shops, their Design, Machinery and Shop Practice," "Train Service and Its Practical Application," "Investments in Street Railways. How Can They be Made Secure and Remunerative?" "Construction and Maintenance of Street Railway Tracks." There will be a large exhibition of street railway supplies, every foot of space in the hall having been applied for.

At a meeting of the Executive Committee held in Chicago, Feb. 6, 1899, the following resolution was adopted: Resolved, That the last day of the convention, Friday, Oct. 20, be set apart for the systematic and careful inspection of exhibits by the delegates, and that all street railway managers be urged to send delegations from the mechanical, operating and accounting departments to inspect same.

The annual banquet will be held on Friday evening, when the officers elect will be installed. The headquarters of the association will be at the Auditorium Annex. The Auditorium is across the street. Chicago is noted for its good hotels, so that no trouble will be experienced in securing good accommodations. Mr. Charles C. Sergeant is president of the association, and Mr. T. C. Penington is the secretary-treasurer.

Patent and Trade-Mark Reform.

At the Buffalo meeting of the American Bar Association, Messrs. Francis Forbes, R. Wayne Parker and E. Q. Keasby, the committee appointed, made a report of the work done by the conference convened at Brussels, in December, 1897, under the Paris convention of 1883, for the Protection of Industrial Property. The work of the conference committee is not finished, having still before it amendments of the convention relating to the duration of the period of delay of priority; the forfeiture of patents for non-working; the admission of trade marks to registration; the usurpation of marks used, but not registered; and unfair competition (concurrence deloyale).

The report resumed the whole history of the convention from Paris in 1880, down to that of 1897, when the conference agreed to amendments providing for the case of citizens of States not members of the Union who desire to take advantage of the provisions of the convention: by striking out "by a third party" in Article 4, so as to leave no doubt but that the inventor himself may use his invention in public and describe it without invalidating his patent; providing for the independence of patents taken out in different countries; modifying Article 9, so as to allow prohibition of importation of goods bearing an unlawful trade mark or commercial name in place of seizure of goods in transit, and making this Article applicable to agricultural products in addition to manufactures; for the date when the adhesion of new members shall go into force; and that each State shall actually accord temporary protection, etc., to exhibits at international expositions, instead of engage to do so, etc.

The most important amendment is that for the independence of patents, which reads as follows: "Art. 4 *bis*. Patents applied for in the different contracting States by persons admitted to the benefit of the convention under the terms of articles 2 and 3, shall be independent of the patents obtained for the same invention in the other States adhering or not to the Union.

"This provision shall apply to patents existing at the time of its going into effect.

"The same rule applies in the case of adhesion of new States as to patents already existing either in the Union or in the new adhering State at the time of the adhesion."

As to the five topics referred to above as open and unsettled, the report says:

"These questions are of the greatest interest to the inventor, manufacturer and merchant. Take the first—the extension of time during which the inventor may apply for a patent. We in the United States do not appreciate the actual position of the inventor elsewhere. Two years are here allowed in which application can be made for a patent after public use, but in Europe the universal rule is that, except where the convention applies, the invention must be wholly secret prior to the application for the patent. It was to break down this rule that the convention was framed. Whatever, therefore, will extend the time for application after publicity (now six or seven months) will more nearly approximate to our system and be of advantage to the inventor.

The second proposition—that a patent shall not be forfeited for non-working, is an addition to rather than an amendment of the convention. The working of an invention within a certain time after the grant of the patent is an almost universal requirement in Europe, in default of which the patent lapses. Whatever extension of this period can be obtained is, therefore, more in harmony with our system, under which no work is required.

Meeting of New York State Electrical Contractors.

The New York State Electrical Contractors' Association held their first annual convention in the Builders' Exchange, Buffalo, on Aug. 29. The Association, which is only three months old, having been formed, in Rochester, through the efforts of Wells Dygert, of Buffalo, is in its early stage of organization. The constitution and by-laws weer adopted at the meeting and other business in the form of preliminary organization was transacted.

Mr. Dygert is taking the first steps in the formation of a national organization, and the State Association is aiding him in his work. A meeting of the State Association will probably be held in Syracuse some time this winter to take further steps, and a call for a meeting to organize the national body will follow. At the present time it is the intention of many of the members of the State Association and all the members of the local association to arrange so that the convention of 1900 can be held in the interior of the State and the convention in 1901 held in Buffalo, on account of the Pan-American Exposition.

Forty members of the State Association attended the convention. The officers are as follows: President, Rudolf Schmidt, Rochester; vice-president, D. Cronin, Syracuse; secretary, Wells Dygert, Buffalo; treasurer, J. C. Stearns, Buffalo. The Buffalo members distributed among the members handsome badges as souvenirs.

Article No. 1 of the rules and regulations provides that the body shall be called the United Electrical Contractors' Association of New York State, and Article No. 2 states that its objects are mutual protection, greater co-operation and the collection of information. The cities represented now are Buffalo, Rochester, Utica, Syracuse, Binghamton, Albany, Troy, Cohoes, Schenectady, Glens Falls, Amsterdam, Newburg and Jamestown. The next meeting is to be held at Troy on Nov. 14, 1899.

Fourth Annual Convention of Municipal Electricians.

The fourth annual convention of the National Association of Municipal Electricians was opened at Wilmington, Del., on Sept. 5. After an address of welcome to the city by the Hon. John C. Fahey, mayor of Wilmington, Gov. E. W. Tunnell welcomed the delegates to the State of Delaware.

A response to the addresses of the mayor and the governor was made by Mr. M. W. Mead, of Pittsburg, after which the president of the association, Mr. J. W. Aydon, of Wilmington, Del., delivered his annual address. A brief historical sketch of the city of Wilmington and State of Delaware by Mr. H. C. Conrad, of Wilmington, followed.

At the afternoon session some routine business was dispensed with, after which Captain Wm. Brophy, of Boston, read a paper on "Licensing of Employees on Electrical Work," including character of electrical work.

Clinton Rogers Woodruff, of Philadelphia, secretary of the National Municipal League, read a paper on municipal government. Mr. Geo. F. Macdonald, of Ottawa, Ont., read a paper on fire and police telegraphs in Canada.

About sixty or seventy members and supply men are in attendance, and the convention was in progress when this report closed on Tuesday night.

Edison Convention.

The regular annual meeting of the Association of Edison Electric Illuminating Companies will begin at the Hotel Lafayette, Philadelphia, on Tuesday, Sept. 12. Mr. W. S. Howell is the secretary. The local Edison interests, with Mr. J. H. Vail in charge, are providing entertainments for the delegates and ladies.

Gasoline Engine, 60-KW, 220-Volt, Watertown, S. D., Central Station.

BY PROF. F. W. SPRINGER.

WATERTOWN, South Dakota, is a place of about 4000 inhabitants, and located in the great northwestern grain belt. There is scarcely a natural grove within 200 miles. It is hardly necessary to say that fuel is expensive, even though the city is the junction point of four railroads. Hard and soft wood cost $5.50 and $4.50 respectively. Youghiogheny coal sells at $5.90 per

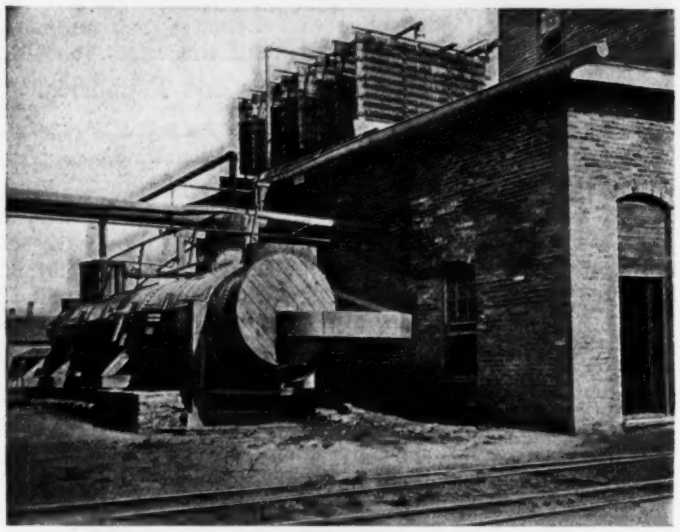


FIG. 1.—PRAIRIE CONDENSING PLANT.

ton. At the time of the installation of the plant to be described, last February, gasoline could be bought for 8 cents a gallon in car lots. The present price is 12⅝ cents.

As in most prairie towns, the water supply for engine purposes is largely limited to surface wells. In the case of power, it was a choice between a gasoline and a condensing steam engine.

A type of condenser which is in favor in the West, where there is plenty of cool wind and a scarcity of water, is shown in Fig. 1. Steam from a 150-hp Corliss engine is exhausted into two boilers, shown in the rear of the building. These boilers are connected with rows of cast iron pipe placed on the roof. Water is allowed to flow down the sides of the coils and on the boilers. It then falls into a tank from which it is repumped into the sprinkling system and again made to do condensing duty. By adding 25 barrels of water a day to make up for evaporation, a vacuum of 16 or 18 inches can be maintained during the hottest weather, while by pumping in all the water which a forty-inch surface well will supply, a vacuum of 26 inches is obtained. It should also be remarked here that a gasoline engine of a given power requires about several times as much water for cylinder cooling purposes as a steam engine of the same rating for feeding its boiler.

A first class engine and boiler, together with such a condensing system as the above, was found to be about equal in cost to the same amount of power in a gasoline engine outfit. The problem thus resolved itself into a question of fuel, labor in operating, maintenance, regulation and reliability. The first three, in this case, were decidedly in favor of the gasoline engine. Difficulty in regulation was expected, but it was thought that it could be overcome. While at first there was some prejudice in regard to reliability, experience has proven that with the same intelligent attention as would be necessary to give a steam equipment, the advantage, if any, is in favor of gasoline.

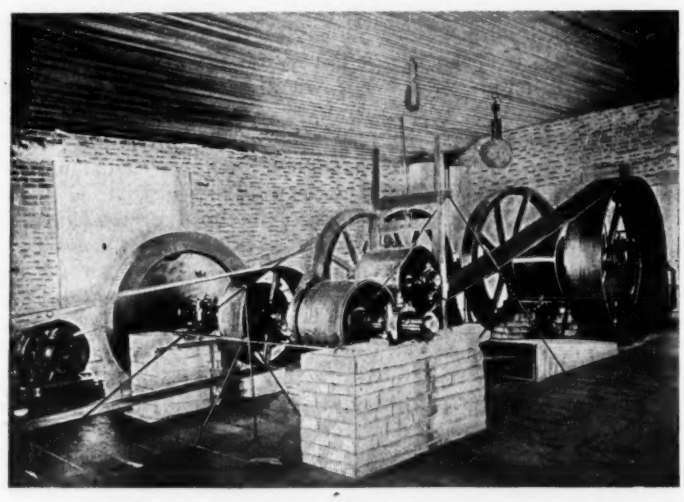
Since the city is quite compactly built up, it was not difficult to settle on a compensating 220-volt system for electrical equipment.

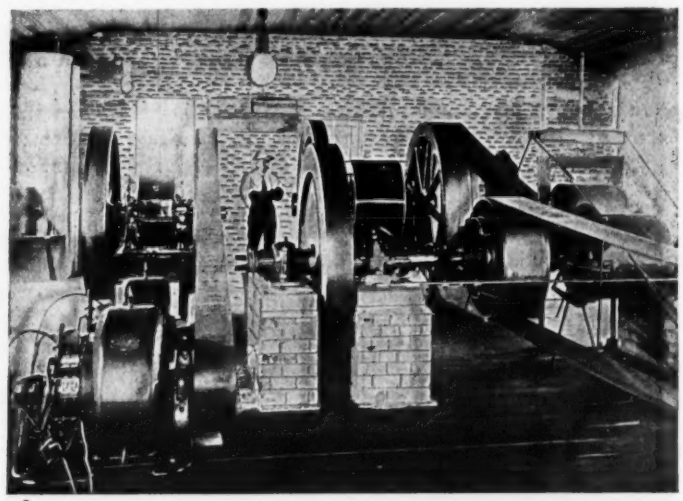
The plant consists of two Otto engines. One is of 60-hp and belted to a countershaft, which drives a 250-volt, 40-kw compounded Crocker-Wheeler generator. On the counter-shaft is mounted a balance pulley (Fig. 2), weighing 3800 pounds and making 640 r. p. m. Both engine and dynamo can be disconnected from the shaft while starting the engine, by releasing the friction clutches. That clutch which connects the engine to the shaft is not set perfectly tight, so that in case of an extra heavy explosion it will slip a little. A 40-hp engine of the same type is belted directly to two 10-kw 125-volt compound generators. (Left of Fig. 3.)

The foundations for the two engines, counter-shaft and large generator are of white brick laid in cement. As a charge in a gasoline engine explodes on the over and out stroke, there is a tendency for the overhanging cylinder to fly back and downward. In case of accident to the regulating apparatus a charge sufficiently large to crack the foundation might get into the cylinder. In the large engine (Fig. 2) this danger is averted by running 1-inch tie rods from the tops of the two front anchor bolts through the floor, at an angle of 45 degrees, to two large telephone poles set with one end against the foundation and weighted down with a ton of rock.

The switchboard is of two panels of polished slate, mounted with Whitney instruments and switches, etc., for the three dynamos and five circuits. Bare copper wire is used for outside mains.

Gasoline is bought in car lots and stored in a 6000-gallon tank. This is connected by an underground pipe line to two 170-gallon tanks (one for each engine) located back of the station and set two feet underground. The oil is raised about 6 feet by the engine pumps. A power pump, which may be run from either engine, raises water from a well 5 feet square by 18 feet deep, and is stored in two 450-gallon tanks placed in the rear of the room. With both engines fully loaded, two tanks of water will not last an hour





FIGS. 2 AND 3.—DYNAMO AND ENGINE ROOM, WATERTOWN, S. D., LIGHTING PLANT.

It is said that when the large engine exhausts directly into the air it can be heard five miles. Such a noise would not, of course, be tolerated. It is done away with almost completely by exhausting into a well 10 feet square, 10 feet deep and covered over with 2½ feet of dirt. The sides and top are covered with 2-inch planking. A 6-inch box set in the top and extending part way into the well furnishes a vent for the vapors. In order to prevent the planking from burning, the waste water from the large engine is run into the well. A part of this water soaks into the ground and spoils all well water for drinking purposes within a radius of 50 feet.

As the exhaust pipes would become red hot if covered with earth within 10 feet of the engines, they are laid in 12-inch tiling for that distance. This tiling is open at both ends, and in the winter time, when all doors and windows are closed, the draft caused by the use of the air in the room by the engines draws fresh air in through the tiling. This air, passing along the hot exhaust pipes, becomes sufficiently heated to quite comfortably warm the room in the coldest weather.

From the load diagram, Fig. 4, it is seen that the small machines (full line) are run continuously, while the large generator is used only on the peak of the load when it is abundantly able to carry all of it at any time. The reason for this apparent unnecessary use of both machines during the period of heavy load is that a large part of the lighting is on the 220-volt 3-wire system, and the neutral wire is connected between the two small dynamos. The

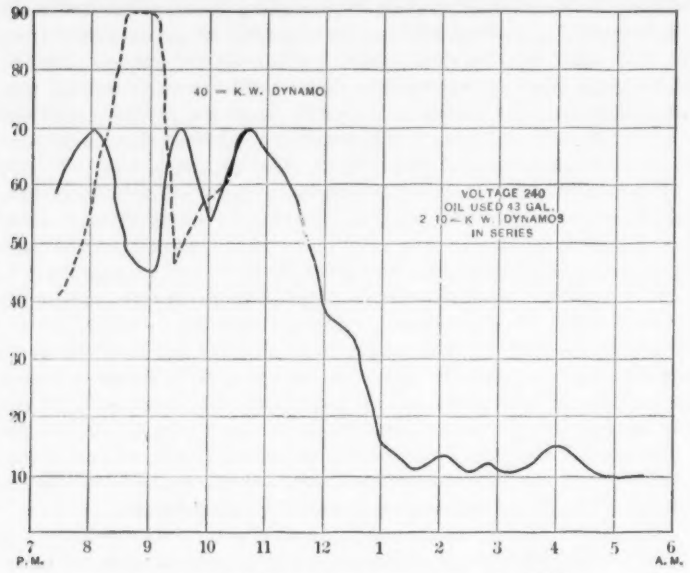


FIG. 4.—AMPERE LOAD CURVE, APRIL 22, 1899.

voltage on the two sides of the 3-wire circuits is thus easily adjusted by the field rheostats of the two 10-kw generators. In case of accident to the small engine, the load on the two sides could be approximately balanced by throwing the station lights and as many of a bank of incandescent lights (arranged for that purpose) as might be necessary, on that side of the system which had the light load.

The variation of speed and voltage in the large unit with its heavy balance wheel is, as might be expected, almost nothing on a constant load. As much cannot be said of the smaller engine, which often shows a maximum variation of 5 volts in 120 volts. In order to avoid "see-sawing" of current while operating the two units in parallel, it was found necessary to greatly reduce the compound-

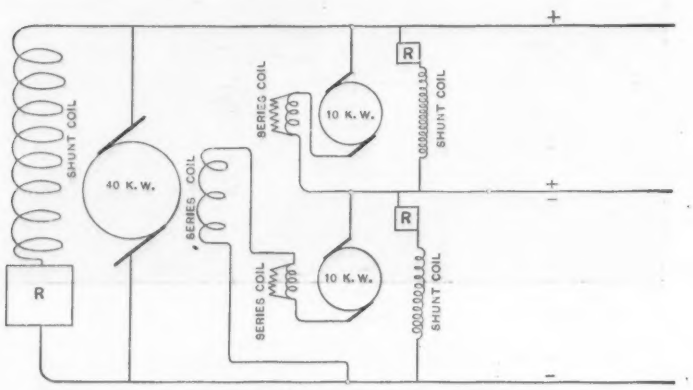


FIG. 5.—DYNAMO CONNECTIONS.

ing of the 10-kw dynamos by shunting their series coils. The current from one of these machines is then sent through the series coils of the large generator, which is thus run as a sort of separately excited shunt dynamo. (See Fig. 5.)

The use of a heavy balance wheel has so effectually eliminated all speed variation troubles in the case of the large engine that the management has already arranged to extend the counter-shaft so that it may be belted to the small engine, and then using a friction pulley of such size that both engines will work together on the same shaft. This latter arrangement will not only prevent the troublesome "see-sawing" above referred to, but will also permit the use of the balance wheel with either engine alone. If necessary, either set of machines could be run from either engine.

Three men easily handle the above station. Fifteen cents per 1000 watts is the basic meter rate. Five dollars and twenty-five cents and $6.00 per month are charged respectively for 1200-cp enclosed arcs on the 10 and 11 o'clock circuits.

The Economy Effected by the Use of the Electric Motor Around Steel Plants, Furnaces and Foundries.

BY ANDREW E. MACCOUN.

OWING to the very rapid growth of electric labor-saving devices around modern steel works, furnaces and foundries, some of the power stations for operating them have been considerably neglected even where the electrical apparatus through the mills are quite modern and up to date. In some districts this, I suppose, has been largely due to the cost of fuel being very cheap, and as the introduction of motors offered many other advantages in labor saving and convenience, the great gain in efficiency effected by their use was somewhat overlooked.

This, of course, was a great mistake because with an economical electric power station supplying motors, there is a gain on an average through a mill-taking all classes of machinery—of over four to one in favor of the electric motor, or less than one-quarter the amount of steam used at the power station will operate the same amount of machinery. It may seem surprising to some that reversing and other engines used around works of this kind are so uneconomical, but the average steam consumption of these engines is over 125 lbs. per horse-power-hour, even when including some of the larger engines, such as used on saws, etc.

It even pays to have economical stations in localities where coal can be had for 50c per ton, as the attendance in the station is not increased much, and there is also a saving effected in the use of fuel, the labor of handling the same, and the repairs on the additional boilers required with the uneconomical station. The extra cost of the economical machinery is fully compensated for by the fewer number of boilers required, together with the additional advantages secured as mentioned above. Power stations for works of this kind are arranged very much like those modern electric railways, except that they are usually operated at 250 volts, as this is found to be a safer voltage to use around the mills and to be much easier to insulate. This latter advantage is very important, as the iron dust and scale collecting on wires would often give trouble with the higher voltage, and it is also much safer for the men working around the machinery.

Direct connected units and compound engines should be used, and the engines run condensing when possible; in some plants, especially when they are near blast furnaces, the water for this purpose can be had for nothing, as the waste water can be used after it has cooled the boshes of the blast furnaces. Of course, the temperature of this is somewhat increased, but even in the summer months it is very little over 90 degrees F, after it comes from the boshes. There are also additional advantages in having the power stations located near blast furnaces, when possible, as the boilers can be supplied with the furnace gases, which entails a great saving, both directly and through requiring no labor to handle.

As so much depends on the power stations around large steel plants, and as they must run month after month without being shut down, great care should be taken in their design. And if possible the piping, engines, etc., should be so arranged that part of the plant can be kept in operation even if repairs must be made on the piping or machinery of the other parts of the station, as a delay caused by shutting down the station would cause great losses and annoyance.

The power switchboards in plants of this kind are designed very much like those used on electric railways, having generator and feeder panels. Each feeder panel should have an ammeter, circuit-breaker, and double-pole switch, as each feeder panel supplies a section of the mills and thus gives the attendants complete control of the system. In addition to the power plant, there are also arc and

incandescent lights required. For the former the series arc system is generally used, as this can very conveniently be run around large works over scattered areas, and gives a saving in copper over any other system.

In stations where the direct connected units are large, it sometimes pays to run the arc machines with motors from the large generators and this is done in some cases. I do not, however, think much is gained in economy by this method when the direct connected units are under 1200-hp, as the arc plants in large works have from 500 to 600 lights. Better economy can be had by running large arc light units directly belted to economical compound engines.

The incandescent machines installed are usually alternating current, as the areas covered in most cares are so large and the lighting so varied, that this system has been found the best adapted for these conditions.

There are at some plants from 300 to 400-hp of machinery of this kind, and in some of these the two-phase or monocyclic system has been used. These were installed more particularly to see what satisfaction polyphase motors would give when used for mill work. I tested some of these motors a few years ago, but they did not give as good results as the direct-current motors, and I once thought of trying one of the later types on a crane in the mills, but the motor and controlling arrangements were so expensive as to be prohibitory. In time they may be somewhat cheaper. but even then it can hardly be expected that they can be controlled as readily and give as large a starting torque and as good efficiency under all conditions of load, when used on this class of work, as the direct-current motor does.

Having given a short discription of the requirements of power stations for steel works and plants of that description, we can turn our attention to some of the labor-saving devices and economies gained in the mills and foundries, and thus get an idea of the different conditions to which the electric motor can be applied successfully and the advantages gained by its use over other classes of machinery.

At steel works where blast furnaces are near the converting mills or open hearth furnaces, it is the most economical method to run the hot metal direct from the furnaces or mixers to the converting mills or open hearth furnaces, whichever it may be, where it can be poured into the converters or open hearth furnaces by tilting the ladles in which it is carried by motors arranged for that purpose. In open hearth furnaces where scrap iron is charged, the Wellman charging machine is very often used; this machine picks up a skip load of material, runs it into the furnace and dumps it.

This machin has made enormous— savings, as before its introduction this labor was mostly done by hand, and in some few cases in which it was done by machines, these had boilers and engines on them, which made them very complicated and hard to keep in repair; besides, their speed and certainty of operation could not be compared to that of the machines operated by motors.

In open hearth furnaces large cranes usually handle the material when it comes from the furnaces, lift the ladles of iron, etc., and pour the iron from the ladles into the ingot molds. In some converting mills cranes also do this work, but in some few cases it is found better to use a small amount of hydraulic machinery, especially near the vessels and under them, as in such places there are sparks flying around, which makes it very hard on electrical machinery.

When electrical machinery is to be used in such places as converting mills, care must be taken in the design of the cranes so as to meet the conditions. If they are carefully designed, they give very good results and in some cases have made savings in the number of men required. Motors in places of this kind should be run at a slow speed and the gearing, etc., reduced to a minimum. The bearings and mechanical parts of the cranes should be adapted for rough usage and designed so that they will collect as little dirt and grit as possible.

In the bottom houses of converting mills motors can also be made to give excellent results. Much labor can be saved by lifting the bottoms from place to place for repairs and for new linings, and running them in the ovens when finished for drying. Of course, in all places of this kind great care must be taken in installing the machinery and wiring, but when the details receive attention and are carefully worked out, the machinery gives excellent results.

After the ingots are taken from the converting mills or open hearth furnaces, they are handled, reheated, drawn out from the furnaces nearly entirely by electrical methods. The works which have used hydraulic machinery for many years are substituting in its place electrical appliances.

Around the mills all the transfer tables are being operated by motors, even in some cases where they are reversed continually for feeding the rolls. There are very few places in mills where motors cannot be introduced. Some of the tables, such as blooming mill and roughing roll tables, are a little hard on motors, due to the constant reversing required, which may be twenty times a minute. Motors, however, have been successfully run even in places of this kind, although it is somewhat hard on the controller and commutators; but I think in time with a few improvements the motor will be able to accomplish this work with as much ease as the engine does. Of course, the engine has compression, which acts as a cushion, and this makes it easy on it where this continual reversing is necessary.

In other parts of mills the finished material can also be handled very advantageously by electrical devices. On hot beds the material can be pulled to the straightening presses, and in such places one man can control from a central position very many motions, and thus effect a saving in labor. Straightening and drill presses, such as are used for finishing material like rails, beams, channels, etc., also offer a good place for the introduction of motors, as the speeds can be controlled. On different classes of material this is very important, as the speeds of the motors can be varied slightly to suit the different classes of work, and the machines can thus do the work more quickly. In all mill work of this kind it is a great mistake to figure too closely on the size of motors—that is, to get them too small—for on machinery like that around mills the bearings are apt to get tight, as those of tables and similar devices, and motors may burn out and cause trouble. When allowance is made and motors are strong for the work required from them, they give splendid results and require little attention, though probably not running quite so efficient as motors run up to full load. I know of some mills where motors were introduced on tables and elsewhere, and afterwards taken out and replaced by small engines; this was entirely due to figuring too closely on the power required, and putting in motors that had not sufficient power to do the work at times required of them. In places where motors must be run and reversed day in and day out, they should be of ample size, and, if well selected, they are as reliable and cause as little trouble as engines, while saving greatly in the many ways described. There are many places in mills where the introduction of electrical machinery more than paid for itself in one year, outside of the gain in efficiency.

There are numerous other places around large works where stationary motors can be well used, such as in machine shops, blacksmith shops, pattern shops, saw mills, etc. Even in some of these cases where motors have been put in the place of engines the services of a man or so have been dispensed with, oil, waste and packing have been saved, the repair account reduced, and long steam lines done away with.

In modern foundries the electric motor has also gradually taken the formost place as a motive power and nearly all other kinds have been dispensed with. This has been largely due to the great economies effected by using electricity, and also the convenience and the ease of control. The older methods of using hydraulic cranes for lifting have nearly all been done away with, large electric cranes having taken their place. The gain in efficiency by the use of the electric crane is large, as the continual loss which goes on in hydraulic systems is avoided.

The cranes that are now being introduced in places of this kind are being made much stronger, both mechanically and electrically, and give very good results, as they are more convenient and handle material much easier than by the old style arrangements. Some of them are three-motor cranes, having bridge, hoist and trolley motors; others have four motors, having an auxiliary hoist on trolley, used for the lighter lifting at higher speed, where in other places it is found advisable to have two trolleys on the bridge. The controllers are usually arranged on an operating cage on the bridge where one man can control all the motions of a crane.

In some foundry work there is a great deal of dust and graphite and this was formerly very hard on the machinery of cranes, especially on bearings, motors and controllers. On the newer cranes, however, most of this trouble is overcome; cast steel wheels are used on the tracks of runways and bridges; the journals are similar to those on railway cars; the shafts run in half boxes which are removable and the lower part of the bearing is stuffed with

oily waste. These bearings are found to give excellent results, and are very easily attended to and kept in good order.

Cut steel gears are used in all places where the speed is at all high. In places where there are lots of dust and graphite as mentioned above, it is advisable to use slow-speed motors, of course, dust proof like the standard street car motor. The trolley and bridge mechanism on these cranes should also be arranged so that they can be easily gotten at for repairs, and simplified as much as possible.

For a time foundry men did not have much confidence in electrical machinery, as high speed frail motors were used on most of the first cranes installed for this purpose, and mostly open motors; these with the controllers were a constant annoyance. This feeling is gradually dying out, as cranes have been improved so much from time to time that now when electrical systems of this kind are well worked out it makes one of the most substantial systems as well as effecting great economy in operaion.

There are quite a number other places around foundries where motors are taking a prominent place, such as strippers for stripping ingot molds of their cores, blowers for cupolas, rumbling barrels for cleaning castings and also about core ovens. In some foundries electric power is the only power made use of for this class of work.

Motors are also used extensively on "skull crackers" for breaking scrap iron and in a great many places of this kind where the skull crackers were situated in out of the way places. I have known of engines and boilers being done away with, lots of coal being saved, and also the services of a fireman dispensed with. In such places one can readily see what great savings have been and are being accomplished by the introduction of electricity as a motive power.

A New Method of Determining Ratio of Transformation.

By J. R. Bibbins.

IT is often a perplexing problem to determine accurately the ratio of transformation of one or more transformers when specially calibrated instruments are not available. The following is a simple and accurate method requiring a single alternating current voltmeter reading from zero to 150 volts, a source of current (100 volts) and preferably a Pohls commutator, although the method may be applied without the commutator with slight inconvenience of changing connections.

The principal value of the method lies in the elimination of errors of observation, which are impossible to avoid when reading at the extremities of the scale of an alternating current instrument. Such instruments work on the principle of the electrodynamometer, and have their scale divisions contracted at either extremity of the scale, making it more difficult to read accurately at those points.

On many instruments the units are omitted entirely and (up to 20

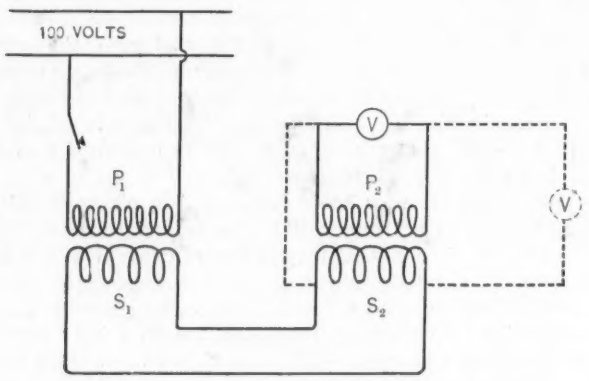


FIG. 1.—DIAGRAM OF CONNECTIONS, WITHOUT COMMUTATOR.

or 30 vents) only the tens are calibrated. This makes it impossible to determine accurately the ratio of a transformer by applying to the primary, say, 100 volts, and reading the reduced voltage, presumably in the neighborhood of 10 volts, on the same scale.

In view of the fact that the greatest accuracy may be derived from readings made in the middle of the scale, the following method becomes of value under the conditions just assumed. As an example of its utility, the writer, in the course of some alternating current work at the University of Michigan, where the method was originated, had occasion to make use of two step-down transformers in order to obtain a very low voltage (0.01 volt). As no accurate voltmeter transformers were available, two experimental transformers were selected, and their ratio of transformation determined by the method set forth in the accompanying diagrams.

Referring to Figs. 1 and 2, T_1 and T_2 are two transformers of approximately the same ratio of transformation, of which the ratio of T_2 is desired. Connect the two secondaries, S_1 and S_2, together, and the primary P_1 to the 100-volt mains or other source of alternating current with a switch in circuit for convenience. First read the voltage at the terminals of P_2 (as indicated by the continuous lines), which will presumably be about 100 volts. Second, connect two terminals of P_2 and S_2, as indicated by the dotted portion of Fig. I. This should be either about 10 or 90

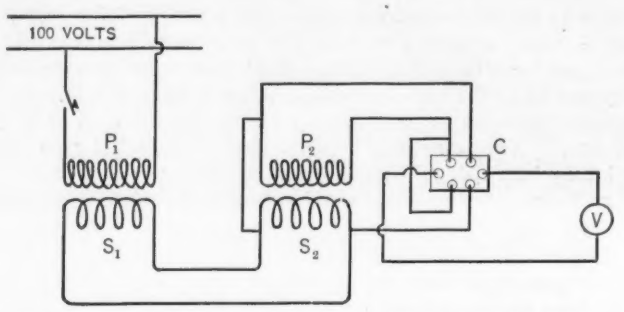


FIG. 2.—DIAGRAM OF CONNECTIONS, WITH COMMUTATOR.

volts, depending upon which terminals are joined together.

Assuming the values,

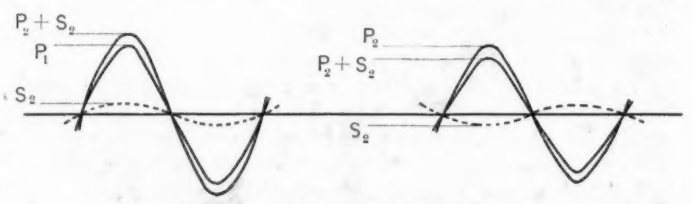
$$P_1 = 100 \text{ volts.}$$
$$P_2 = 102.6 \text{ "}$$
$$P_2 + S_2 = 111.25 \text{ "}$$
$$P + S_2 = 93.95 \text{ "}$$

Then ratio of T_2 =

$$\frac{P_2}{(P_2 + S_2) - P_2} = \frac{102.6}{111.25 - 102.6} = \frac{102.6}{8.65} = \frac{1}{11.861}, \text{ or ratio of transformation} = 11.861 \quad (1)$$

$$\frac{P_2}{P_2 - (P_2 + S_2)} = \frac{102.6}{102.6 - 93.95} = \frac{102.6}{8.65} = \frac{1}{11.861}, \text{ or again, ratio of transformation} = 11.861 \quad (2)$$

The identity of these results obtained in the above cases is ex-



FIGS. 3 AND 4.—TRANSFORMER PHASE RELATIONS.

plained thus: It is well known that at no load the primary and secondary e. m. fs. of a transformer are displaced in phase 180°. If then S_2 is superposed upon P_2, as in Fig. I, whether S_2 will be subtracted or added to P_2 will depend on whether S_2 is in phase with P_2, as in Fig 3, or 180° behind it, as in Fig. 4. That this feature is altogether immaterial is evident by observing that the dotted curve S_2 is derived in either figure by subtracting ordinates, and as only the numerical value of S_2 is required, the phase relations may be entirely disregarded.

If the voltage of the alternating current source is fairly constant, accurate results may be obtained without the use of a Pohls commutator, but if there is considerable fluctuation in voltage, its use will insure much more reliable results, as the voltmeter may then be transferred instantly from one circuit to another.

The ratio of transformation of T_1 may be found in the same manner as that of T_2 by a simple interchange of position and connections.

This method the writer found satisfactory in every respect, and, never having seen it described in technical literature, believes its simplicity will commend itself to alternating current workers.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN 377

The Storage Battery in Telephone Exchanges.

Modern telephone practice has made a great advance by centralizing the batteries needed by the subscribers in talking. This practice not only results in direct saving of cost of battery power,

BELL TELEPHONE EXCHANGE, PHILADELPHIA.

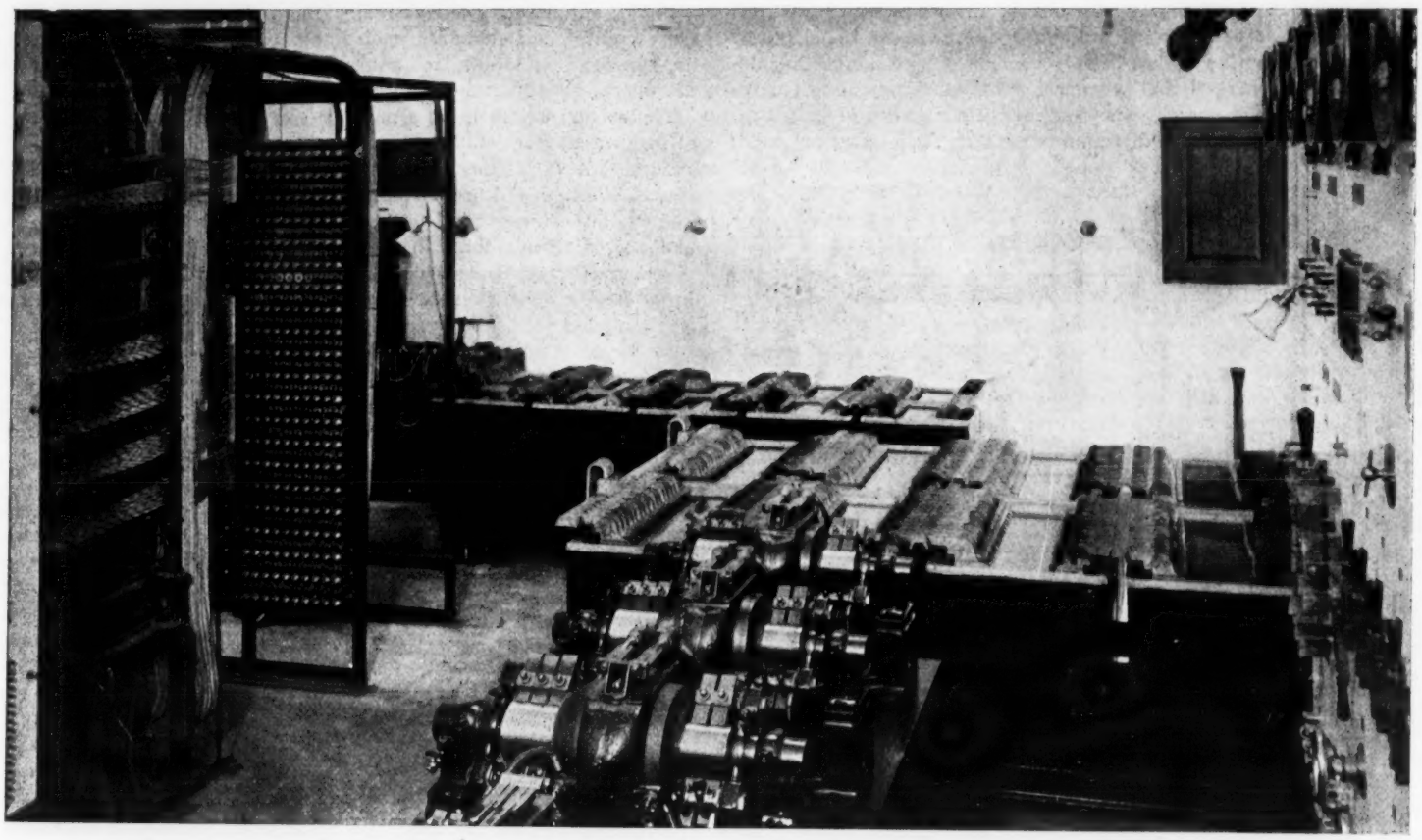
but also materially improves the efficiency of the service by having the batteries together and in a place where they are under constant supervision of experienced men. The storage battery also furnishes all current for automatic signaling. A typical telephone installation of this kind is that put in operation in the exchange of the Bell Telephone Company, of Philadelphia, situated at the corner of 11th and Filbert Streets, in 1898.

Situated in the engine room are two machines, forming a duplicate plant, each consisting of one engine, direct coupled to a 30-kw 110-volt dynamo. These machines are run alternately every other day, and are used for lighting the building and furnishing power at 110 volts to motor generators in the power room on the sixth floor used for charging the storage batteries and furnishing ringing power to the telephone switchboard. The motor generators have their primary ends connected to the 110-volt direct-current circuit fed from the generators in the basement.

These motor generators comprise two 1500-w machines for charging a 20-volt battery, one 1500-w machine charging an 8-volt battery; one 500-w machine charging a 4-volt battery, and two ¼-hp, 75-volt alternating-current motor generators for ringing. Only one machine is furnished for the 8-volt and the 4-volt batteries which are in duplicate. To avoid a possible breakdown, an enamel rheostat is furnished, so that the batteries of lower voltage can be charged from batteries or motor generators of higher voltage. All machines are protected with automatic safety cut-outs.

The 20-volt battery consists of ten Type 13-G chloride accumulators having a capacity of about 1000 ampere hours, which furnish all the current needed by the subscribers for talking and for calling up the office. The 8-volt batteries, in duplicate, each consists of four Type 31-G cells, having a capacity of 2400 ampere hours. This battery furnishes current for the "disconnect" signals on the operator's cords, and for the relays which cut out the subscriber's lamp signal when the operator answers his call by plugging into the jack corresponding to the lamp signal. The disconnect lamps are so wired that they burn only when the subscribers connected by the cord need attention from the operator. They do not light while the subscribers are talking.

Half the drop in potential of the 8-volt battery is in the 4-volt lamp, and the other half in the cut-out relay. This battery is in duplicate, so that one can be charged while the other is being discharged. This avoids danger of burning out the lamps, as the voltage of the battery is raised from 8 to 10 volts during charging. The 4-volt battery consists of six 13-F cells in duplicate. One of these sets consists of four cells, two in series, two in multiple; the other of two cells. The two extra cells are needed on one of the batteries to supply current for the operators' transmitters. This battery is arranged to furnish a current of four volts or two volts as desired. The 4-volt battery also furnishes all current for lighting the lamp signals which light when a subscriber takes his telephone off the hook. This lamp is put out when the operator answers the call as was described under the 8-volt battery. This



GENERATING AND STORAGE BATTERY PLANT, BELL TELEPHONE EXCHANGE, PHILADELPHIA, PA.

battery is made in duplicate, one being charged while the other is discharged, to avoid burning out the lamp from the higher voltage during charge.

The power switchboard and mounting fuseboard are constructed of white marble, mounted on an iron frame, and equipped with switches, measuring instruments, fuses, etc., for the necessary circuits.

The function of the battery is as follows: The subscriber, by taking his telephone off the hook, operates a relay at the central office, which operates a 4-volt lamp in front of the operator at the switchboard; this lamp is extinguished as soon as the operator plugs into the jack. The cord with which the operator connects together the jack of the subscriber calling with that of the subscriber desired is wired to the 20-volt battery, which furnishes all the current used by the subscriber in talking. The automatic 4-volt lamp "disconnect" signals on the operators' cords are operated in the manner already described.

This storage battery installation has turned out even beyond the expectations, and when one considers that it replaces thousands of cells scattered over a wide area among subscribers, its convenience, as well as its economy and reliability, will be appreciated by others besides telephonists. It seems, indeed, only a question of time when all telephone exchanges will have their electrical energy concentrated at the central office under the constant supervision of the technical staff.

New Telephone Exchange and Multiple Switchboard Patents.

Two patents were issued August 29 to Charles E. Scribner, one on a telephone-exchange system, for which application was filed Dec. 18, 1888, and the other on a multiple switchboard system, for which application was filed Nov. 14, 1891, and renewed Nov. 16, 1896.

The first mentioned patent relates to an invention which consists, first, in the use of polarized individual annunciators in telephone lines, in combination with a battery connected with connecting devices and so arranged that when any two lines are connected together, the battery current will be closed through the polarized individual annunciators in a direction to prevent their being operated;

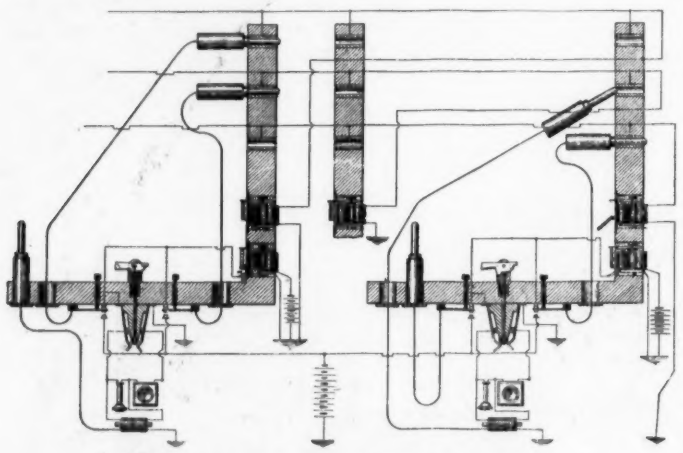


FIG. 1.—SCRIBNER TELEPHONE SYSTEM.

second, in extending each line from its switch or plug socket on the last board through a polarized individual annunciator and thence to ground, the annunciators being of high resistance and provided with a larger number of turns to act as inductances when two lines are connected together; third, in providing connecting, signaling, answering and testing apparatus at each of the boards so arranged that communication may be had between the central office and the different subscribers' stations, as desired, to enable one subscriber to be put in communication with any other idle subscriber; fourth, in a special battery circuit in connection with the connecting devices, whereby the individual polarized annunciators of two connected lines are prevented from being thrown down while connected for conversation, the presence of the battery current on any lines thus connected at one board affording means for testing the lines at any other of the boards; fifth, in a differentially wound clearing-out annunciator, the battery circuit connected through said coils, and a branch from between said coils to a pair of cords or other connecting devices, the different windings of the annunciators being of a different number of turns and so apportioned that

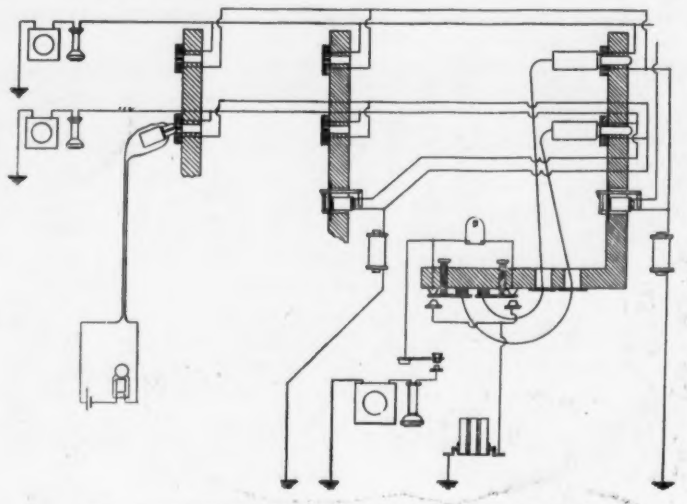


FIG. 2.—SCRIBNER MULTIPLE SWITCHBOARD SYSTEM.

when two lines are connected by the cord, the current through the different windings will be such as to practically neutralize the core.

The specification states that by the use of this invention the spring jack switches heretofore generally used may be dispensed with, simple metallic sockets being employed instead; moreover, no special test wires are required in multiple systems. The system is claimed to be of special advantage on account of simplicity and cheapness, as the problem of wiring large boards, which has been considered heretofore one of the most difficult, is by this means made easy since only half the number of connections are required, the special test circuits, one for each line, being dispensed with.

Fig. 1 is illustrative of three telephone lines, each connected with three multiple switchboards, each line extending from its socket on the last board to a polarized annunciator and thence to the ground, the operator's apparatus being shown at the first and last boards.

The second patent is on a multiple-switchboard system. Instead of using a single metallic socket or a spring-jack switch in case of grounded lines, as has been usual heretofore, for each terminal a socket is employed, consisting of two insulated portions. Each line extends from ground to one portion of each of these terminals and passes thence through an annunciator of, say, one hundred ohms resistance, and thence through a retardation-coil to the ground. Between the retardation-coil and annunciator of each line is provided a branch connection which extends to the other side of each of the terminals of the line.

The apparatus for connecting the lines consists of pairs of flexible cords provided with terminal plugs. A plug being inserted in any line-terminal electrically connects the two portions of the terminal through the medium of the plug, thus shunting out the resistance of the individual annunciator of the line. Thus normally there is a bridge or cross connection between the wire and the return circuit of a telephone line, including serially the annunciator of the line and a retardation or a resistance coil. When connection is made with the line, a path is closed from the line through the registering contact-pieces of the socket and the plug in the socket to the bridge at a point intermediate of the annunciator and impedance-coil, so that while a shunt or short-circuit is formed for signaling currents about the annunciator, the impedance-coil remains in a permanently closed bridge of the line circuit.

This method of preventing the operation of the line annunciator of a line by signaling currents sent subsequently to the establishment of connection with the line—which consists in shunting the signaling current from the annunciator by means of a by-path completed in the socket, the bridge of the circuit remaining permanently closed—constitutes an important feature of the invention, which feature may, of course, be applied either in single or in multiple switchboards. In either case the usual clearing-out annunciator and operator's listening-key are connected with the circuit of the plugs to afford other means by which connected subscribers may signal to the attendant.

When this device is associated with lines in multiple switchboards, in which a socket of the line appears in each section of the switchboard, the like contact-pieces of the sockets are connected

together by conductors, the circuit formed for shunting the annunciator being the same as before. It becomes necessary in such a case, however, to provide means at one section of the switchboard whereby an operator there may test a line to determine whether it be already in use through a connection at another section of the switchboard.

The means arranged for shunting the annunciator serve also in the organization of a new test system, which constitutes a second feature of the present invention. To this end apparatus is provided with appliances by means of which it can be determined whether or not the resistance of the individual annunciator is shunted out of the circuit. This testing apparatus consists, preferably, in a circuit containing a battery and buzzer proportioned with respect to electromotive force and ampere-windings, respectively, so that the buzzer will not respond when connected with the circuit of a line so as to include the resistance of the individual annunciator, but so that the bell or buzzer will respond when the resistance of the annunciator is shunted or removed from the circuit.

Fig. 2 shows diagrammatically two telephone lines, each connected with three different switchboards, and through an annunciator and a retardation coil to ground, with the keyboard apparatus at the last board and the testing apparatus at the first board in position to test one of the lines.

The Field of Experimental Research.*

BY ELIHU THOMSON.

PHYSICAL research by experimental methods is both a broadening and a narrowing field. There are many gaps yet to be filled, data to be accumulated, measurements to be made with great precision, but the limits within which we must work are becoming, at the same time, more and more defined.

The upper ranges of velocities, temperatures, and pressures, which manifest themselves in the study of the stellar universe, are forever beyond the range of experiment. But while the astronomer must wait for opportunities to observe, the experimenter can control his conditions and apply his methods and his apparatus at once to the question in hand. Still this work must be done within a certain range or must be limited to conditions more or less easy to recognize. In spite of this fact, however, the progress made during the past century is not likely to cease or abate in the next, and the ever-increasing number of workers bodes well for the future enrichment of our science.

Whatever may be our ideas of fundamental entities, as expressed in various theories; whether, as an example, we regard the ether as like an infinitely mobile fluid, or as an incompressible solid, or as a jelly; or whether we incline to think that being an electromagnetic medium, it may be without mechanical properties, which properties depend in some way upon the electromagnetic nature of the ether; we cannot reach sure ground without the experimental test.

The development in the field of research by experiment is like the opening of a mine, which, as it deepens and widens, continually yields new treasure, but with increased difficulty, except when a rich vein is struck and worked for a time. In general, however, as the work progresses there will be needed closer application and more refined methods. We may indeed find our limit of depth in the mine of experiment in inordinate cost, in temperatures too high, or in pressures beyond the limits of our skill to control.

It is but a few months since Prof. Dewar, by the evaporation of liquid hydrogen in a vacuum, closely approached, if he has not reached, our lower limit of possible temperature. Investigations of the effects of low temperature upon the properties of bodies must from the present outlook be forever limited to about 20° C. above absolute zero; unless, a lighter gas than hydrogen be discovered upon the earth, the actual existence of which it is, of course, impossible to conjecture. Before the actual experimental demonstration of this limit, the limit itself was known to theory, at least approximately, but the spur of the experimenter is the overcoming of difficulties and the possibility of new discoveries which come as surprises. In the case in question a liquid of extremely low density, only one-fourteenth that of liquid nitrogen, was produced, while still defined by clear and well-marked refracting surfaces.

When we turn to the consideration of the field for research work at high temperatures we are not confronted by the fact of a physical limit existing; which may be approached but never reached. We can imagine no limit to possible increase of temperature, such as is the absolute zero limit of decrease. While we may actually employ in electric furnaces temperatures, which, according to Moissan, have a lower limit of 3500° C., we can realize the possibility of temperatures existing in the stars measured by tens of thousands or hundreds of thousands of degrees of our temperature scale.

The moderate increase of working temperature given by the electric furnace, enabled Moissan and others to reap a rich harvest of experimental results, and the natural inference is that much more might be expected from further extensions of the limits. These limits are, however, already set for us by the vaporization of all known substances. Our furnace itself keeps down the temperature by melting and volatilizing. We may indefinitely increase the energy in an electric arc and thus add to the heat evolved, but the addition only goes to vaporize more material. The limit of work then seems to be readily reached in the electric furnace, no materials for lining being available, not subject either to fusion or vaporization, thus using up the energy which would otherwise go to increase the temperature.

A suggestion as to a possible extension of temperature range may be made here. It may be requisite to work with closed receptacles under pressure, and to discharge through them electric currents of so great energy-value as to attain almost instantaneously the highest temperatures, to be maintained for only a very short time. We may imagine a huge condenser charged to a potential of, say, 10,000 volts as discharged through a limited body of gas contained in a small space within a strong steel tube which has a lining of refractory non-conductor. The energy may thus possibly be delivered so suddenly to a very limited body of material as to result in a momentary elevation of temperature passing all present known limits and capable of effecting profound changes in molecular constitution. We need all possible extension of the limits of research in this direction in order to discover some clue to the relations which the chemical elements bear to each other. The limit of possible strength of the containing receptacle, or some unforeseen factor, would probably set the new bounds. The point to be here enforced, however, is that far beyond any increase of working range in temperature, obtained in any way, there must still exist a further range unattainable by our best efforts and possibly forever outside of the field of experimental research. Our knowledge of this higher range can alone be derived from a study of the actions going on in the stars and nebulæ.

As with the temperature range so it is with the pressure range. We may easily work under conditions which involve no pressure, but when we attempt to conduct our inquiries with increase of pressure, we soon find a limit to the tenacity of our strongest vessels, or to our ability to produce and maintain extreme pressures. We may work, not easily it is true, with pressures up to a few tons to the square inch, but this is as nothing compared with the condition which we know must exist within the larger celestial bodies; without reference to their condition, solid, liquid, or gaseous. Can we ever hope to experimentally reproduce the condition of a mass of gas so compressed that in spite of a very high temperature its volume is less than that of the same mass cooled to solidification? Yet this extreme of condition must be the normal state within the bodies of many of the stars.

It has been aptly said that many, and perhaps most, of the important discoveries have been made with comparatively simple and crude apparatus. While this may be true, yet it is probably true also that future advance work is likely to require more and more refined means and greater nicety of construction and adjustment of apparatus. The expense or cost, if not the difficulty of the work, may become so great as to effectually bar further progress in some fields. When instruments require to be adjusted or constructed, to such refined limits as a fraction of a wave-length of light, but few can be found to undertake the work. The interferometer and echelon spectroscope of Michelson involve such minute adjustments, that a wave-length of light is relatively thereto a large measure. It is well known that this comparative coarseness of light waves imposes a limit to the powers of optical instruments, as the microscope and telescope, such that no perfection of proportion, construction and correction of the lenses can remove.

In most fields of research, however, progress in the future will depend in an increasing degree upon the possession by the investigator of an appreciation of small details and magnitudes, together with a refined skill in manipulation or construction of apparatus. He must be ready to guide the trained mechanic and be able himself

*Vice-Presidential address, delivered at the Columbus meeting of the American Association for the Advancement of Science.

to administer those finishing touches, which often mark the difference between success and failure. There must be in his mental equipment that clear comprehension of the proper adjustment of means to end, which is of such great value in work in new fields. He must also learn to render available to science the resources of the larger workshops and industrial establishments.

The application of physical principles upon a large scale in such works, has frequently, in recent years, resulted in great gains to science itself. The resources of the physical laboratory are often relatively small and meagre compared with those of the factory. Experimental work in certain lines is now frequently carried on upon a scale so great and under such varied conditions as would be almost impossible outside of a large works.

In no field has this been more true than in that of electricity during the past few years. We need only instance the progress in alternating currents and in relation to the magnetic properties of iron. In large scale operations, effects which would be missed or remain masked in work undertaken upon a more restricted scale, receive emphasis sufficient to cause them to command attention. The obstacle of increasing costliness of equipment, which in some fields might act as a bar to further progress, can only be overcome by more liberal endowments of laboratories engaged in advance work. Even those in the community who can only understand the value of scientific work when it has been put to practical use, may find in the history of past progress, that many discoveries in pure science, which had not, when made, any apparent commercial importance or value, have in the end resulted in great practical revolutions.

Could Volta, when he discovered the pile one hundred years ago, have had any idea of its importance in practical work? Or, did Davy or his contemporaries at the time of his experiments with the arc of flame between the charcoal terminals of his large battery, have any suspicion that in less than one hundred years, the electric arc would grow to such importance that more than 100,000 arc lamps would become a single year's production in this country alone. Faraday, when he made his researches upon the induction of electric currents from magnetism, could not have had any idea of the enormous practical work in which the principles he dealt with as facts of pure science, would find embodiment. When he wound upon the closed iron ring the two coils of wire which enabled him to discover the facts of mutual induction, he had begun, without any suspicion of the fact, the experimental work which gave to science and to practice, the modern transformer, now built of capacities ranging up to 2500-hp each, and for potentials of 40,000 to 60,000 volts.

These examples, and many others which might be given, should convince even the most arrogantly practical man of the high value of scientific research, not alone as adding to the sum total of knowledge and for the admirable training it gives, but because it cannot fail to have an ultimate practical effect. Discoveries which at first seem to have no useful nor practical outcome are often the very ones which underlie development of the greatest importance in the acts and industries.

The work of Hertz upon electric waves was to the physicist a grand experimental demonstration, tending to prove the truth of the electromagnetic theory of light, and subsequent progress was profoundly influenced by it, though no practical use followed at once. The physicist to-day may see in the wireless telegraph only an extension of Hertz's original work, for he need not consider the commercial or economic outcome. He may, however, recognize the fact that in the wireless telegraph as developed by Marconi, practice calls for a broader theoretical view. Certain elements of construction and adjustment of apparatus at first used and regarded as essential from a theoretical standpoint, have already been laid aside. The radiator with its large polished brass spheres and special spark gap has been found of no more effect than the simple pair of small balls ordinarily constituting the terminals for high potential discharges. It has been found that the transmitting and receiving apparatus do not require to be attuned and that the receiving coherer is not the true recipient of the electric wave or disturbance in the ether.

These later developments are in fact departures, more or less wide, from the principles underlying the Hertz demonstration. A vertical wire is charged to a high potential and discharges to earth over a spark gap. During the discharge the wire becomes a radiator of electromagnetic pulses or waves, regardless of the spark radiation. The receiving vertical wire is likewise alone relied upon to absorb the energy. Being in the path of the electro-magnetic wave conveyed in the ether from the transmitting wire, it becomes the seat of electromotive forces, which break down the coherer. This, in substance, may be considered as a series of small or microscopic spark gaps which can be crossed by the comparatively low potentials developed in the receiving wire. We are thus taught to recognize the fact that the refinements in methods and apparatus needed for a delicate physical demonstration, as of the Hertz waves, in this instance, may often be laid aside in practical application, where the end to be achieved is different. The sudden discharge of the Marconi transmitting wire may possibly give rise to a series of oscillations or high frequency alternating waves in the wire, but since the first half of the first wave at each discharge will have the greatest amplitude, it is doubtful if those which follow in the short train have any decided effect upon the receiver. According to this view, the fact of the discharge being oscillatory may, indeed, have no essential relation to the work done, but may be an unavoidable incident of the very sudden discharge which itself would set up a single-pulse in the ether sufficiently intense for the work even if unaccompanied by lower amplitude oscillations following the first discharge pulse.

Before leaving the consideration of this most fruitful field of experimental research opened by Hertz, it may be stated that the one gap in the work yet to be filled is the actual production of electric waves of a wave-length corresponding to those of the spectrum. If this could be done by some direct method, no matter how feeble the effect obtained, the experimental demonstrations of the electric nature of radiant heat and light would be fitly completed. Several years ago it occurred to me that it might be possible to devise a method for accomplishing the end in view, and so close the existing gap. Many years ago an observation on sound echoes showed clearly the production of high pitch sounds from single pulses, or lower pitch waves. A bridge over a mile in length was boarded at the sides, and vertical slats regularly and closely placed along its side formed, for a sound wave incident thereon, a series of reflecting edges or narrow vertical surfaces, a kind of coarse grating. It was found that a loud sound or pulse, such as that of a gun shot, emanating from a point near one end of the bridge and two to three hundred feet in a line from the structure, was followed by an echo which was in reality a high pitch musical tone. The pitch of this tone corresponded to the spacing of the slats in the bridge considered as a reflecting grating for sound.

Following this principle, it seems possible that a very sudden pulse in the ether or electromagnetic wave, incident at an angle upon a reflecting grating having from 20,000 to 40,000 ruled lines to the inch, if the plane of incidence were at right angles with the rulings might be thrown into ripples of the wave length of light and yield a feeble luminosity. If the color then varied with the angle of incidence chosen and with the angle through which the reflection passed to the eye, the experiment would be conclusive.

Despite the diligent studies which had been made in the invisible rays of the spectrum, both the ultrared and ultraviolet, a work far from completion as yet, the peculiar invisible radiation of the Crookes tube remained unknown until the work of Lenard and Röntgen brought it to the knowledge of the world. The cathode discharge, studied so effectively by Hittorf and Crookes, and by the latter called "radiant matter," was but a part of the whole truth in relation to the radiation in high vacua. It is needless to recount the steps in the discovery of Röntgen rays, we now know that these rays come from the impingement of the "radiant matter" or cathode rays. We know also that the higher the vacuum and therefore the higher the electric potential needed to effect the discharge, the more penetrating or the less easily absorbed is the resulting radiation. Rays have been produced which in part pass through cast iron nearly an inch thick. The iron acting as a filter absorbs all rays of less penetrating power. A question may here be put, which it will be for future experiment to answer: Can we by increasing the degree of vacuum in a Crookes' tube by the employment of enormous potentials for forcing a discharge through the higher vacuum, produce rays of greater and greater penetrating power? What, in fact, may be the limit, or is there any limit to the diminution of wave-length in the ether, assuming for the moment that this invisible radiation is somewhat of the same nature as light, but of higher pitch, though it may be unlike light in not representing regular wave trains.

Röntgen radiation while spoken of as invisible, is in reality easily visible if of great intensity. The parts of the retina which respond and so give the sensation of luminosity are apparently those around the eye and not directly opposite to the iris opening. These parts of the retina sensitive to the rays are characterized by the preponderance of "rods," giving the simple sensation of illumination, apparently white in the case in question. The "cones," or those portions of the retinal membrane whose function is believed to be the recog-

nition of color or differences of wave-length, appear not to be excited by the Röntgen radiation, or only very feebly. If this be true it would account for the less intensity of the luminous effect upon those portions of the retina near the optic axis of the eye. All this favors the view that the Röntgen radiation is without sustained pitch or wave trains, and resembles more a sharp noise or crash in sound.

For pressing experimental work in the highest vacua to its limit, as above suggested, we already have means at command for the production of the most complete exhaustions, requiring extremely high potentials to pass an electric discharge. We have also in well known forms of high frequency apparatus the means for producing electromotive forces limited only by our means for insulation. A recent apparatus devised by me and called a dynamo-static machine, gives equal capability of producing high potentials of definite polarity, positive and negative. It should not be long, therefore, before work is undertaken in this suggested direction of pressing this matter of rays of high penetrating power much farther than has been done. The question arises whether any such rays can exist which are not appreciably absorbed in passing through dense substances. They would probably not affect a photographic plate nor a fluorescent screen. If they lost also the property of ionizing a gas and causing electric convection, we might not even be able to discover them. That some influence or action in the ether does actually penetrate the dense masses in space is evidenced by gravitation, the mystery of mysteries. We are, however, not justified in going beyond the proved facts which can only be the result of experimental work and close observation. All else is speculation.

The energy source of the Becquerel rays is another mystery apparently far from being cleared up, and if it be true, as recently announced, that a substance named radium, has in reality nine hundred times the power of emitting these rays that is possessed by uranium and thorium, and that the radiation is able to cause visible fluorescence of barium platinocyanide, the mystery but deepens and makes us again think of the possible existence of obscure rays only absorbed and converted by a few special substances.

The diffusion which takes place when Röntgen rays pass through various media is another phenomenon which needs more attention from investigators. This effect seems to be produced by all substances in a greater or less degree. It, however, appears to be nearly absent in the case of those substances which give out light or fluoresce under the rays, as barium platinocyanide and calcium tungstate. It will be important to determine definitely whether the rays diffused by different substances are lowered in pitch or penetrating power as compared with the rays exciting the diffusion; whether, in other words, the rays from a tube with quite high vacuum, excite similar rays by diffusion, or rays more absorbable; and if a lowering takes place, whether it occurs in like manner and degree for all diffusing media.

The phenomenon may be akin to fluorescence, as when quinia sulphate converts the invisible ultraviolet rays of the spectrum into lower rays or visible light. The action may be at its extreme when barium platinocyanide excited by Röntgen rays, so lowers the pitch as to produce rays within the visible spectrum, for this compound gives very little or no Röntgen ray diffusion. Are there substances which under Röntgen rays fluoresce with invisible rays of the order of the ultraviolet of the spectrum? If, as is the case with solid paraffine, the irradiated substance give rise to considerable diffusion, it can, as Prof. Thomson has noted, produce a secondary diffusion in other masses of the same substance, or of other substances, as indicated by feeble fluorescence of the sensitive barium salt, thoroughly screened from the direct source of rays and from the first or primary diffusion. It is probable that tertiary diffusion could be found if we possessed a far more powerful or continuous source of the rays for exciting the initial diffusion. The ray emission, even in the most powerfully excited tube is probably so intermittent that the active period is but a fraction of the total time. It may easily be that the limit of intensity of Röntgen ray emission has not yet been reached, especially when artificially cooled anticathode plates are available.

There is much room for experimental work in this fascinating field. There is needed for it the means for the production either of a continuous electric discharge at from 60,000 to 100,000 volts, or a high frequency apparatus capable of giving an unbroken wave train, that is, a succession of high period waves of current without breaks or intermissions.

The ordinary high frequency apparatus for obtaining discharges of high potential from alternating currents, gives only a rapid succession of discharges each consisting of a few rapidly dampened oscillations. These discharges occupy but a small fraction of the total time. This is very different from a continuous sustained wave train, with the successive waves of equal amplitude following each other without break. Such sustained waves would doubtless be of use in research, especially in vacuum tube work, and they would of course convey much more energy than the usual broken or interrupted discharge known as a high frequency discharge.

Some six or seven years ago I endeavored, while working upon the subject of high frequency, to fill the gap. The result was an apparatus which, with its modifications, deserves more study and experiment than I have been able to give to it. A brief description may not be out of place. A large inductance coil with a heavy iron wire bundle for a core, a coil of relatively few turns with no iron core, and a condenser of variable capacity, were connected in series across the mains of a 500-volt electric circuit. The smaller coreless coil and the condenser were arranged to be shunted by an adjustable spark gap with polished ball terminals. By simply closing for a moment the spark gap so as to form a low resistance shunt around the condenser and the small coil, and afterward slowly separating the balls, the local circuit of the condenser, small coreless coil and shunting gap become the seat of sustained oscillations, the frequency of which depends upon the relation of inductance and capacity in the local circuit. The energy supplied is that of a continuous current through the large inductance coil with the heavy core. The action of the apparatus is easily comprehended by a little study. The oscillating current in the local circuit may be made to induce much higher potentials in a secondary circuit inductively related thereto. In this case the turns of the secondary in relation to the primary, are, as usual, such as to step-up the potential. In other words the potential developed in the secondary is determined by the transforming ratio.

We thus have a high frequency apparatus in which the waves are sustained in an unbroken series, and we employ as the source of energy a continuous current circuit. It shows that we may continuously supply energy to an oscillating system and so keep up the amplitude of electric oscillations, the frequency of which is that due to the capacity and inductance of the part of the circuit in which oscillations are set up.

While, in the forms of high frequency apparatus alluded to, we may obtain almost any differences of electric potential up to millions of volts, assuming the apparatus large enough for the work, we do not get a sustained separation of positive and negative charges, as in the static machine, or in a less complete degree with the inductive coil. Prof. Trowbridge, of Harvard, has, however, made use of large Planté rheostatic machines, the condenser plates of which are charged in parallel from 10,000 small storage cells connected in series. The discharge of the condenser plates is effected after they are connected in series by a suitable connection—changing frame moved for the purpose. Very high potential discharges are thus obtained and the polarity is always definite. It is manifest that the size of the apparatus and the perfection of its insulation determine the possible performance. The objection to such an apparatus for experimental research or demonstration is the large number of cells required and the complicated arrangements of circuits for charging them. I have, however, recently succeeded in removing all necessity for the presence of charging cells, and have produced what may be termed a dynamostatic machine which is worked by power or by current from a lighting circuit, either continuous or alternating, and may replace a static machine. It is, of course, not dependent upon the weather. I trust it may be of sufficient interest to merit the following brief description:*

A small electric motor has, in addition to its commutator, a pair of rings connected to its armature winding for obtaining alternating currents. The shaft of the motor drives synchronously a revolving frame bearing connections which, as in the Planté rheostatic machine, connect a series of condenser plates alternately in parallel for charging and in series for discharging at high potential. A small oil immersed step-up transformer has its primary connected to the brushes bearing upon the two alternating current rings of the motor, and its secondary, giving, say, 20,000 volts, is periodically connected to the condenser plates while in parallel by means of the revolving connection frame. The adjustment is such that only the tops of the alternating waves or their maxima are used to charge the condenser plates, while, also, those halves of the waves which are of the same polarity are alone used, the others being discarded or left on open

*An illustrated description of the apparatus referred to will be printed in a future issue.

circuit. The apparatus may be driven by power, in which case the electric motor becomes a dynamo, exciting its own field and supplying alternating current to the primary of the step-up transformer, or, suitable alternating currents may drive it as a synchronous motor. Such a machine run by continuous currents and having only eleven plates, gives sparks between its terminals over twelve inches long in rapid succession. It can be built cheaply, and is a highly instructive machine from the transformations it illustrates.

The machine is also arranged, by the addition of a simple attachment , so that it may be used to charge insulated bodies, or to charge Leyden-jar condensers or the like, replacing the ordinary static machines. It might, in fact, be used to charge a second range of condenser plates in another rheostatic machine to a potential of 100,000 volts, for example. These, after coupling in series or cascade, might be made to yield potentials beyond any thus far obtained.

The interest in such experimental apparatus and the results obtained, comes largely from the apparent ability to secure a representation of the effects of lightning discharges upon a moderate scale, and the possibility of studying the action of air and other gases, as well as liquids and solids, at varying temperatures and pressures under high electric stresses. Broadly considered, however, the similarity of the effects to those produced in a thunder-cloud is more apparent than real. The globules of water constituting the electrified cloud do not possess charges of millions of volts potential, the effects of which are seen in the stroke of lightning. The individual globules may possess only a moderate charge. When, however, they are massed together in a large extent of cloud the virtual potential of the cloud as a whole, with respect to the earth, may be enormous, though no part of the cloud possesses it. The cloud mass not being a conductor, its charge cannot reside upon its outer surface or upon its lower surface nearest the earth, as with a large insulated conductor. The charge, in fact, exists throughout the mass, each globule of water suspended in the air having its small effect upon the total result.

When the cloud discharges, the main spark branches within and through the cloud mass in many directions. The discharge can at best be only a very partial one from the nature of the case. These are conditions which are certainly not represented in our experimental production of high potential phenomena, except perhaps upon a very small scale in the electrified steam from Armstrong's hydroelectric machine, a type of apparatus now almost obsolete. Yet if we wish to reproduce as nearly as possible upon a small scale, the conditions of the thunder-cloud, we will be compelled to again resort to it. In volcanic eruptions similar actions doubtless occur and give rise to the thunder-clouds which often surround the gases sent out from the crater.

Considering then that the conditions in the thunder-cloud are so different from those in our experiments with high potentials, we can easily understand that the study of lightning phenomena may present problems difficult to solve. Two forms at least of lightning discharge are quite unknown in the laboratory; namely, globular lightning and bead lightning, the latter the more rare of the two. Personally I cannot doubt the existence of both of these rare forms of electric discharge, having received detailed accounts from eye witnesses. On one occasion, while observing a thunder-storm I narrowly missed seeing the phenomenon of globular lightning, though a friend who was present looking in the opposite direction, saw it. The explosion, however, was heard and it consisted of a single detonation like the firing of a cannon. According to the testimony of an intelligent eye witness, who described the rare phenomenon of bead lightning within an hour after it had been seen, it is a very beautiful luminous appearance like a string of beads hung in a cloud, the beads being somewhat elliptical, and the ends of their axes in the line of the discharge being colored red and purple respectively. This peculiar appearance, not at any time dazzlingly bright, persisted for a few seconds while fading gradually.

Again, our knowledge of the aurora is not as yet much more definite or precise than it is in regard to the obscure forms of lightning alluded to above. Whether these phenomena will ever be brought within the field of research by experimental methods is an open question.

The endeavor in the foregoing rather disconnected statements has been to indicate directions in which the field of experiment may be extended, and to emphasize the fact that research must be carried on by extension of limits, necessitating more liberal endowment of research laboratories. I have tried to make it clear that the physicist must avail himself of the powers and energies set in play in the larger industrial enterprises, and finally that the field of possible exploration in physics by experimental methods has its natural boundaries, outside of which our advances in knowledge must be derived from a study of celestial bodies.

The riddle of gravitation is yet to be solved. This all permeating force must be connected with other forces and with other properties of matter. It will be a delicate task, indeed, for the total attraction between very large masses closely adjacent, aside from the earth's attraction, is very small.

Scientific facts are of little value in themselves. Their significance is their bearing upon other facts, enabling us to generalize and so to discover principles, just as the accurate measurement of the position of a star may be without value in itself, but in relation to other similar measurements of other stars, may become the means of discovering their proper motions. We refine our instruments, we render more trustworthy our means of observation, we extend our range of experimental inquiry, and thus lay the foundation for the future work, with the full knowledge that although our researches cannot extend beyond certain limits, the field itself is, even within those limits, inexhaustible.

A Magnet Phenomenon.

BY ARTHUR H. FORD AND BUDD FRANKENFIELD.

Some years ago the writers made a discovery which is of some scientific interest, and which promises to find a field of application.

The electrical engineering laboratories of the University of Wisconsin are provided with the commercial alternating current of the city of Madison. Two frequencies are used here, 125 cycles per second during periods of light load, and 60 when the load is heavy. In order to ascertain the frequency in use at any time, and yet avoid telephoning to the power house, a "howler" was constructed after the fashion of a Bell telephone receiver, a magnetized rat-tail file serving as the permanent magnet, with the usual coil and diaphragm to complete the outfit. The apparatus having been adjusted for a loud tone, the ear could easily detect the frequency on pressing a button, which closed the circuit through the "howler." The note could be heard from any part of the large dynamo room, above the noise of the machinery. It served its purpose well, and is probably still in use; but the writers were greatly surprised, at first, to find that the note of the "howler" was an octave below the hum of a transformer on the same circuit. Since then the same effect has been shown with two receivers, one having a soft iron core, the other a permanently magnetized core. Following is an explanation of the phenomenon:

In the case of the soft iron core, the diaphragm is attracted toward the core at every pulsation, positive or negative, and recedes to a maximum distance when the current passes through zero. When a permanent magnet is used for a core, however, there is a variable attraction always due to the same polarity, the permanent magnet and coil acting in unison during half a cycle, and in opposition the other half. As a result, the diaphragm is deflected toward the core at every other pulsation, or with half the frequency of that of the soft core receiver; and thus emits a note an octave below that of the latter. Care should be taken that the ampere turns in the case of the hardened steel core be so proportioned as not to demagnetize it.

Sale of Street Car Transfers.

Street railroad managers in Illinois are asking for a law making it a criminal offence for any unauthorized person to sell, give, or buy a transfer ticket. In Chicago the business of scalping in transfer slips has increased enormously. There is no concealment about it, men or boys being stationed at street railroad intersections and shouting, "Transfers you don't need?" Many of the boys make from $2 to $3 a week, and some of them earn as much as $4. Three cents is the regular price demanded from the traveling public for scalpers' transfers, and many men do much of their street car riding on the three-cent transfers. A recently developed phase of the swindle is interesting. Most of the newsboys are eager to swap any evening paper for a transfer. Therefore, when some men start home in the afternoon or evening, they never fail to call for a transfer, whether it is needed to land them at their destination or not, to exchange for a paper.

Direct-Alternating Generators.

BY ALTON D. ADAMS.

THE grounds of contention concerning direct and alternating currents have changed, but there are still differences of opinion to be settled. The question now is not so much whether to employ direct or alternating current in central station work, as it is where to employ each to the best advantage.

Many engineers now hold that alternating currents are superior for transmission and direct currents better for distribution, but the question remains as to where transmission ends and distribution begins. Again, it is said that direct current distribution is better suited to that part of the load which is grouped near or about the station and alternating current more available for load further away or in outlying districts. To many minds it is quite clear that a heavy compact load near the station can be more cheaply served with direct current, and equally certain that a distant load can be cared for at less expense with alternating current.

At an earlier date in the development of the central station industry the decided differences of opinion concerning direct and alternating currents usually resulted in the selection of the one to the exclusion of the other in a given station system, but the later views tend to the use of both currents from the same plant.

Purely direct current stations are looking to-day eagerly toward valuable loads beyond their economical radius of supply, and not a few alternating current stations would gladly escape the disadvantages of the transformer system in their heavy, nearby loads.

Managers see in the alternating current a longer arm for business, and in the direct more economical operation of heavy adjacent loads. So much for incandescent lighting, but there are the motor and arc lamp loads to be cared for.

In spite of the development of alternating current motors and their extending application it seems certain that the direct current motor is here to stay. A very large part of the power now distributed by electric motors in the United States, probably 80 to 90 per cent., is used in the direct current type; and there is small prospect that stations supplying direct current to heavy, compact load areas will change to alternating supply for motors. Moreover the investment of consumers in tens of thousands of direct current motors, which is being augmented by the daily output of a score or more factories making only direct current machinery, is a factor of enormous weight against any change that would send these motors to the scrap heap. It being conceded that direct currents will continue to be used in large measure for power distribution, their production is another problem to be considered in connection with changes in central station design.

It may be said that as a large per cent. of direct current motors are now operated from incandescent lighting mains, the remainder of this class of motors may be so operated and power beyond the radius of these mains supplied from alternating-current motors, but there is much doubt whether this plan can be carried out in practice so long as direct-current mains remain at about 240 volts pressure. Direct-current motors supplied with current from central stations are in almost all cases operated at about either 240 or 500 volts pressure, and the 500-volt motors are in many cases much beyond the distance from supply station at which power at 240 volts can be economically delivered. Should the 220-volt incandescent lamp come into general use, as is to be hoped, there is good reason to think that all direct-current motors from central station supply may ultimately be served from the same mains with incandescent lamps, as practical experience seems to indicate that 500 volts is about the maximum pressure that should be allowed at machinery directly under the consumers' control, and a three-wire system with 220-volt lamps will give about 480 volts on the outside wires of mains. Until the 480-volt direct-current three-wire system comes into use, however, an independent 500-volt motor circuit will be found necessary in many cases.

The high tension series arc lamp has largely disappeared from interior lighting, and the low pressure lamp operated from incandescent mains taken its place.

Several reasons contributed to this change, the independent circuit, the exposed class of wiring, the extra fire and life risk and the uncertainty of service inherent in the high tension series system, have all operated to exclude it from buildings and confine it to out-of-door work. Long distance street lighting remains the one class of service in which to date there is no satisfactory substitute for the high tension series arc, and there seems small prospect of its displacement in this field during some time to come. Whether the direct or alternating current arc will ultimately occupy the commanding position in series arc work is an open question, but in either case the constant current feature remains.

As no practical plan has yet been put into operation by which approximately constant currents can be obtained from either direct or alternating current generators of large capacity without intermediate devices, it seems that special equipment for series circuits must be retained in some form by all stations operating high tension arcs. Above brief review of existing conditions in electrical supply indicates that a large station in the average city will probably find it necessary to furnish to consumers low pressure, direct current on the three-wire system for incandescent lamps, indoor arc lamps and motors low pressure alternating current for incandescent and arc lamps and motors, 500-volt direct current for motors and high pressure constant current, either direct or alternating for series arc lamp circuits. As is well known, the effort to furnish all or even a part of these various currents in the past has resulted in station equipments made up of numerous, small, dissimilar units, incapable of either multiple operation or of being satisfactorily driven by a few large economical engines.

During the past two years a strong tendency has been at work toward a reduction in number and uniformity in character of central station units, in order to work all main generators in multiple and concentrate the entire load at any one time, whatever its character, on as few engines as possible, thus insuring the greatest economy in steam consumption and the highest reliability of operation. Where but one pressure and kind of current is wanted this plan is as simple in operation as it is ideal in conception, but as the consumers rather than central station managers ultimately select the classes of service required it may readily come to pass that a central station under the new plan will have more than three times the capacity of electrical equipment engaged in carrying some parts of its load, that was necessary under the old plan and be saddled with nearly a proportional increase of losses in electrical machinery. Of course, the greater steam economy and more perfect reliability may more than offset the greater first cost of the electrical equipment and its lower combined efficiency, but it certainly seems desirable to maintain the amount of auxiliary electrical equipment and the corresponding losses as low as possible.

In new stations designed on the plan of uniform units the locations of auxiliary electrical apparatus rightly vary according to the position of the main plant. Where the generating station is so far from the principal load area that a high pressure must necessarily be used to reach it with a reasonable outlay for conductors, the first problem is really one of transmission, and therefore quite different from the frequent case where the station is at one side of or surrounded by its heavy load area. It is at once obvious that a generating station so distant from its load area as to require a high transmission pressure should contain only the equipment necessary to generate the high pressure currents, leaving to the substations the auxiliary apparatus necessary to generate the several kinds of current for distribution circuits. When located so near the great bulk of its load that high pressure for transmission, except to outside districts, is not desirable, the generating station will usually contain a large part of the electric auxiliaries as well as the main dynamos and engines, and it is this common sort of a station that requires the best engineering judgment in the selection of apparatus.

Consider, for example, a central generating station so near a large part of its heavy load area that a low pressure direct current is desired for a large per cent. of the total capacity, this direct current to be distributed at about 240 volts on the three-wire system to incandescent and arc lamps and motors.

Let there be a further direct current load of 500-volt-motors over an area too wide for the 240-volt system, also a large series arc lamp load. Surrounding the area served by low-pressure direct-current mains assume a large amount of business that can best be reached by alternating currents and transformers. On the basis of similar generating units, as commonly installed, the main dynamos, direct connected to their engines, will all be of either the alternating current or the direct-current type, and the necessary auxiliary motors and generators or converters will be installed to change the energy delivered by the main dynamos to the forms desired for the several classes of distribution aside from that supplied directly from the main dynamos. Suppose that the main generators are selected of the alternating current type, and of a pres-

sure suited to supply transformers in the outlying districts, then there will be necessary at the station the following auxiliaries:

Rotary converters and transformers for the 240-volt three-wire system.

Rotary converters and transformers for the 500-volt motor system.

Transformers and rectifiers or motors and arc dynamos for the direct-current arc lamps.

If direct current is decided on for the main generators the auxiliary machinery will include:

Rotary converters and transformers for the alternating current high-pressure system.

Motors and arc dynamos, or other devices for the arc lamp load.

In this case the 500-volt motor circuit may be operated from two of the main generators connected in series, though but one of these two may work in multiple with the system at the same time, this method being possible through the use of 240-volt generators to feed into the two outside wires of three-wire mains.

Whether alternating or direct-current main generators will operate a given system with greater economy under above conditions of load depends on a number of circumstances, as the relative amounts of the direct and alternating current service and the means employed to generate the high tension arc current.

Storage batteries were not included in above list of auxiliary apparatus, because equally desirable with either arrangement. In the station with main generators of the alternating type, there must be for each kilowatt capacity of direct current for the three-wire and 500-volt motor systems, at least three kilowatts capacity in main generators, transformers and rotary converters, combined, and from two to three kilowatts total capacity in main generators and transformers, or motors and arc dynamos for each kilowatt capacity of constant arc current.

The capacity for alternating current is represented at once by the capacity of the main alternating generators.

With main direct-current generators, high-pressure alternating current can only be produced by a station capacity in generators, rotary converters and transformers of three times the alternating current output. With ordinary arrangements the combined capacity concerned in the production of high tension arc currents will be three times their output. In direct current capacity, generators and station for this case coincide.

Whatever the advantages in steam consumption per unit of output from main generators, there is certainly little that represents simplicity, low first cost or economy of operation from an electrical standpoint in the use of three kilowatts capacity of electrical machinery to do what one kilowatt capacity did before, and it seems hardly possible that a system requiring so many auxiliary units and transformations represents the final solution of the central station problem.

Perhaps the first solution to suggest itself for these disadvantages is in the use of a few large direct-connected units, part being of the direct and part of the alternating current type, but this violates the essential idea of units interchangable on any part of the load, and all working in multiple unless the rotary converter with its transformer is again introduced, and this last arrangement brings matters again to nearly their present position. There is apparently but one other direction in which to seek betterment of these latest conditions. Generating capacity having been concentrated in a few large units, each of these units must be given ability to produce either or both of the two great classes of current, alternating and direct—that is, they should be direct-alternating generators.

In the station outlined above let each main generator be able to work at full capacity, as either alternating or direct current, and therefore capable of multiple operation with any of the others, on either kind of supply, let each generator also be able to supply a part of its capacity as direct current and a part as alternating current at the same time. If now the direct current side of each generator is designed to operate at either 125 or 250 volts for the three-wire system and the 500-volt motor circuit, the rotary converter is no longer necessary, and the output of constant pressure direct current is equivalent to the generator capacity thus engaged. This saves equivalent capacities in transformers and rotary converters over the case where the main generators are for alternating curent only. To produce low pressure alternating current the same generators that work on the direct-current mains are employed, and any desired alternating pressure obtained by means of transformers, thus saving the cost of and losses in the rotary converters necessary when the main generators produce only direct current. The only decided advantage as to the series arc lamp service with this combined type of generator is that all of the combinations possible for its production with either alternating or direct currents are available. Its saving in first cost, efficiency and floor space seem to warrant a prominent place in modern central stations for the direct-alternating generator.

CURRENT NEWS AND NOTES.

TO FIGHT UNJUST STRIKES.—The Employers' Association, representing from seven to nine millions of local capital, has been organized in Spokane, Wash., to resist any unjust demand of organized labor in the city. The lumber mills, breweries, flour mills, street car companies, electric light company, gas company, water power company, factories, contractors and merchants are all named as represented in the association, which is said to number fifty of the most prominent companies, manufacturers, contractors and other business men in Spokane.

CONDITIONAL FRANCHISES FOR PORTO RICO.—The War Department has began a new policy in the matter of franchises by granting a revocable license to Ramonde de Valdez to construct a system of canals and electric lighting and power works on the Rio Plata at a point about 17 miles above San Juan, Porto Rico. This is the first license of the kind yet issued. Mr. Valdez is a native Porto Rican, and the War Department was induced to grant the license because the construction of the plant means the expenditure among the distressed inhabitants of Porto Rico of about $200,000. The license is made revocable because the department is advised that legally it can go no further, but must leave its action open to the approval of Congress.

TROLLEY FOR SCHOOLS.—The State of Pennsylvania has a law, like that in several other States, permitting the discontinuance of small schools and the transportation of the pupils to a central school. It was enacted in 1897, but little use has hitherto been made of it. A township in Allegheny County now proposes to apply it in a novel way. In other States transportation under such circumstances is by wagons, the vehicles calling at the houses of the pupils, but this Pennsylvania township purposes to use the trolley. The township is represented within the boundaries of an island. The junior school building is located at one end of the island and the advanced school at the other end. The distance to either is too great for many of the pupils to walk, and rather than erect a new building the township School Directors are making preparations for the transportation of the children by the trolley railway at a rate of from two to two and one-half cents per pupil each way. The next step in such sweet uses of electricity will be the employment of automobiles as school omnibuses.

PENALIZING TROLLEY POLITENESS.—Reference was made in these pages last week to the polite and graceful way in which German trolley conductors do their work. The conditions at Hamburg, however, do not favor such amenities. The trolley cars there offer seats for 20 to 28 persons, 10 to 14 on each side. Besides, 4 persons are allowed on the front and 5 persons on the back platform. The full number of passengers being on the car, the conductor lowers a sign, "Besetzt," which means "occupied," and a car can not take more passengers than the above number. The regulations in this respect are very strictly observed. Say, for instance, a lady steps on the car at a halting place, while the conductor is front, collecting fares, the car being already "occupied" when the lady stepped in; but there being no conductor to prevent, she goes inside, and a gentleman offers her his seat, the gentleman then taking a stand on the platform. The conductor returns to his post, when the gentleman is requested to step off the car at the next halting place, having forfeited his seat and the car being fully occupied. Should he refuse to leave the car, he is put off. The policemen on the streets have instructions to watch the cars sharply when passing their post; and if they detect a car carrying one person more than the fixed number, the policemen note the number of the car, and the company receives word that the said conductor has been fined 72 cents, to be deducted from his wages and to be paid to the police board. If a comptroller of the company steps on the car and detects a surplus of passengers, he notes the number of the conductor, who is fined 72 cents, which is paid to a charity fund and divided once a year to employees of the company requiring support.

ITALIAN ELECTRICAL CONGRESS.—A National Electrical Congress will be held Sept. 18 to 23 at Como, Italy, in the new buildings of the Volta Centenary Exposition. The Congress will be opened by a commemorative address on Volta by Prof. Righi, and during its sessions papers will be read by Profs. S. P. Thompson, P. Blaserna and G. Grassi, and Engineer G. Semenza. A discussion on electrical terminology will be introduced by Profs. Donati and Grassi. A meeting of the Associazone Elettrotecnica Italiana will be held in connection with the congress.

STORAGE BATTERY FOR ELECTRIC VEHICLES.—A patent was issued Aug. 29 to H. H. Knepper for a type of storage battery adapted for electric vehicles and other uses in which the battery is subjected to considerable shaking and jarring. The plates of the battery, which may be of the ordinary type, are completely surrounded—on the faces, edges and ends—with an envelope formed of sheets of absorbent material, and in the spaces between these envelopes perforated fillers or sheets of absorbent material are also placed. When the electrolyte is put in the cell, the perforated fillers as well as the porous envelopes absorb the electrolyte and expand, thus making a compact structure which will effectively hold the active material in position and prevent the dropping of the same to the bottom of the cells, short-circuiting of adjacent plates being thus obviated. The material of the absorbent envelope and fillers consists of paper or cardboard made of pulp or other fibrous material. The perforations of the fillers form enclosed receptacles for the electrolyte, thus permitting the employment of a greater quantity of the liquid than could be present if the fillers were solid.

ARC LAMP CONTROL.—In a patent granted Aug. 29 to Herbert A Wagner and Denney W. Roper, method is described for operating arc lamps on constant-potential circuits, whereby it is claimed the efficiency of distribution is increased and the cost of operation reduced. The inventors have found that if the carbon tips are first heated to redness in any suitable way, as by a current too weak to lift the carbons, sufficient carbon vapor will be formed to maintain the arc when the normal current is applied to the lamp, thus obviating a sudden rush of current through the lamp circuit far above the normal and doing away with chattering, which latter annoyance ordinarily requires for its alleviation the use of expensive cored carbons, the employment of dashpots or the use of a fixed resistance kept constantly in the lamp circuit. The arc-lamp circuit contains a resistance in parallel with a short-circuiting switch; in starting up the short-circuiting switch is opened and the resistance thus introduced keeps the current down to a predetermined value, and after having remained in circuit a sufficient length of time for the carbon tips to become heated, is short-circuited out, when the normal arc lamp current flows.

MATHEMATICS AND ITS TRUE APPLICATION.—Some time ago we referred editorially to the manner in which some writers treat alternating current purely as a branch of mathematics, and criticised their neglect to translate the result of a mathematical operation into its proper physical terms. As bearing on this subject, we extract the following from a very interesting paper on "The Fundamental Relations of Algebra," read by Prof. Alexander Macfarlane before the recent Columbus meeting of the American Association for the Advancement of Science, the extracts being quotations from a recent "Treatise on Universal Algebra," by Mr. Whitehead, of Trinity College, Cambridge: "In order that reasoning may be conducted by means of substitutive signs, it is necessary that rules be given for the manipulation of the signs. The rules should be such that the final state of the signs after a series of operations according to rule shall, when the signs are interpreted in terms of the things for which they are substituted, denote a proposition true for the things represented by the signs." The same writer quotes with approval a saying by Stout, that substitutive signs is a means of not thinking about the meaning which it symbolizes, and their use in reasoning is to economize thought.

AUTOMATIC MOTOR CONTROL SYSTEM.—A patent was granted Aug. 29 to J. B. Blood and Frank A. Merrick, for a means of automatic motor control especially applicable in electric traction. As applied to a small car or train unit, the circuit having been closed to the motors, each motor or set of motors then passes under the control of its own automatic controlling device, and is continually accelerated until the maximum speed attainable under the given conditions of load is reached, or until the circuit is again broken, in which latter case all the controlling devices automatically return to the position of lowest acceleration effect. The automatic control depends for its operation on the changes of the counter e. m. f. of the motors, resulting from changes in the speed, whereby electromagnetic devices connected across the motor or armature terminals are actuated. The electromagnetic devices consist of a solenoid or electromagnet acting on a core or armature which operates to close a switch against the action of a spring. There are several electromagnets for each motor, which are connected in series with one another and in shunt with the armature of the motor to be governed. Each magnet is wound with a different number of turns, so that with a given current flowing through the circuit each of the magnets will be at a different point of excitation, and the switches controlled by several magnets operate to short circuit successively the resistances in the motor circuit. With the first flow of current through the stationary armature, a difference of potential due mainly to the ohmic resistance of the armature is maintained across the ends of the magnet circuits. As the armature rotates, however, and its c. e. m. f. builds up, the flow of current increases through its circuit, and when it has reached a predetermined amount, the first magnet operates its short-circuiting bar, thus cutting the first section of resistance out of the main circuit. With this reduction of resistance the main current is again augmented, the accelerating force on the armature is continued and the c. e. m. f. builds up, which in turn forces a stronger current through the magnet circuit until the magnet of the second largest number of turns operates to short circuit the second resistance section; and so on until all of the resistance is short circuited, and the full e. m. f. of the source of supply is applied to the motor terminals. On breaking the current in the main circuit by opening the main switch, the current in the magnet circuit ceases with the fall of the c. e. m. f. of the armature, and the springs carry the short circuiting arms immediately out of contact with the resistance terminals, and all is ready for another start whenever the main switch is closed. The specifications describe how the system is applied to series-parallel electric railway motor control and to the multiple-unit system of electric traction.

SELF-STARTING SINGLE-PHASE MOTOR.—A patent was issued Aug. 29 to Riccardo Arno, of Turin, Italy, on a means for dispensing with auxiliary starting coils on single-phase motors. The specification states that the inventor has discovered that by inserting an additional resistance into the closed coil armature—that is, the rotor—and by imparting to the armature an initial motion of very slow speed, such as may be obtained by turning it by hand, asynchronous single-phase motors can be started without the use of a rotating magnetic field, and with only one group of coils—the mains coils—fed with current. The additional resistance must be capable of admitting of gradual reduction so as to be switched out gradually and without shocks just before the motor is gotten up to speed. Under these conditions it is stated that the strength of current during the whole period of starting will at no time exceed its strength just as the motor begins to turn. Trials carried out on large motors of 100-hp or more under no load, except the friction of the belt or loose pulley, prove that the additional resistance to be inserted in the armature has a value which nearly corresponds to that required to absorb the effective current during the normal running of the motor under the same load. It is added that this condition is much more favorable than what takes place during the starting of asynchronous single-phase motors fed with auxiliary starting coils for the purpose of causing them to act as polyphase motors in getting up to synchronism. The theoretical value of the resistance to be inserted in the armature is $r = .414\,2\pi n L$, n being the frequency and r and L the resistance and inductance, respectively, of each of the elementary armature coils. As illustrated there are three elementary armature coils, each connected to a collector ring on the shaft and, through its respective ring and brush, to a resistance adapted to be cut out by turning a three-armed lever on a rheostat, thereby gradually reducing, and finally short-circuiting the resistances. To obviate the necessity of starting the rotor by means of an impulse given by the hand, means are shown whereby this can be accomplished simply by throwing in a switch, as follows: The rotor coils are rendered unsymmetrical at the instant of starting, which is done by switching one of the coils in open circuit, which will be sufficient to cause the starting of the machine provided it be not at a dead point, and the stopping of the machine at a dead point can always be avoided by a judicious operator. This process also affords a convenient means for reversing the direction of the motor.

MAGNETIC LEATHER CUTTING.—A leather cutting device invented by Henry Parsons, of Marlboro, Mass., is claimed to solve the problem how to arrange for the continual moving of the dies on the block other than by the hands of the man operating the machine. The dies weighing from ten to twelve pounds, as many changes were necessary during the day, work being thus made slow. By this new arrangement such movements are superseded, all that the operator has to do being to change the dies when necessary and do the cutting as easily as he operates his machine. On the beam of the sole leather cutter is an iron carriage, extending from which is an arm, attached to the latter being two spindles, and at the end of these is a megnetized hand-like fixture, which firmly holds the die—this receiving its power from a tiny dynamo arranged as a convenient point on the ceiling of the room, and transmitting its power to the clasp below. The invisible power in question firmly and securely holds the die in position, while the carriage and spindles allow of the easiest and most pliable motion that can be desired.

SOME EFFECTS OF AUTOMOBILISM.—The Marquis de Chasseloup-Laubat, conspicuous among the French sportsmen who have devoted much time and labor to the development of the automobile, has an article in the September *North American Review* in which he tells a most interesting story of "The Progress of Automobilism in France." The Marquis gives the history of the original invention of this new style of vehicle, and points out the influences which retarded its advance into use as a practical means of locomotion. He describes the various test races which have taken place in France under the auspices of the Automobile Club of France, and sets forth the lessons taught by the results of these races, as to the strong and weak points of the different kinds of machines—steam, electric and petroleum—respectively. The reflections of the Marquis as to the economic and social changes likely to be brought about by the new method of locomotion are suggestive. He says: "The study of practical mechanics will receive an extraordinary impulse among all classes of the population, and out of it will grow a rapprochement between idle wealth and the laboring man. Distance will be of less importance than in the past in countries that boast a network of good roads. With mechanical vehicles in general use it will be an easy matter to live 20 or 30 kilometres from the place of one's daily avocations, especially in summer, and it will be considered a promenade to go for breakfast 50, 100 or 150 kilometres away from home. Profound modifications will undoubtedly result from this, not only in country life, but, what is more important, in the life of a numerous class inhabiting our large cities. Automobilism, even more than our suburban railway lines, will cause the great city of the future to extend even further than it has in the past, and will permit a greater number of men to enjoy the ineffable blessing of pure air, of green grass and of sunlight. Automobilism is a means of progress, of well-being and of civilization."

LETTERS TO THE EDITORS.

Electricity Direct from Carbon.

To the Editors of Electrical World and Engineer:

Sirs:—I have been greatly interested in what has appeared in your columns for years past and is now appearing, relative to obtaining electricity direct from the oxidation of carbon; and hence, am led to give an experiment that I made along this line, thinking probably a little light may thereby be added to the subject.

I took a piece of oxide of copper, such as is used in Edison-Lalande batteries, and a piece of carbon, and placed them in contact, applying heat from a gasoline torch to the juncture. The idea was to cause the oxygen from the copper oxide to unite with the carbon, forming the products of combustion, carbon monoxide or dioxide, leaving metallic copper from the oxide, and at the same time generate a current of electricity. I was enabled to obtain a little electricity by this means. The current was even and continued so long as the heat was steadily applied.

For the want of suitable measuring instruments I was unable to determine the values of e. m. f. and current. The copper oxide was reduced to metallic copper, but I was unable to tell whether the oxygen combined with the carbon or with unburnt particles of gasoline. The part of the carbon in contact with the oxide was reduced partly to a fine powder.

PINE BLUFF, ARK. F. HARDIE JEANNIN.

A New Type of Motor and Unipolar Dynamo.

To the Editors of Electrical World and Engineer:

Sirs:—It is well known that if a hollow copper cylinder surround the pole of a permanent magnet, and if an electric current be passed along the cylinder parallel to its axis and to that of the magnet, the cylinder will rotate if a sufficiently delicate means of leading off the electric current be provided. A ring-shaped cup of mercury may be used for this purpose at the lower end of the cylinder, and a metallic cup containing mercury may be at the top of the cylinder, and connected with one of the terminals of the battery.

Now, according to the principle of reaction, if the copper cylinder be kept stationary and the electric current be passed along it, as before—that is, parallel to its axis—the magnet should rotate on its own axis if properly mounted on pivots so as to diminish the friction. In this case mercury cups would not be required; the wires from the battery might be directly fastened to the top and to the bottom of the hollow copper cylinder. We should thus have a direct-current electric motor without either commutator or rubbing contacts of any kind where the current enters and leaves the armature. If this machine be unconnected with a battery or other generator of electricity, when we mechanically rotate the magnet the machine becomes a unipolar dynamo without any rubbing contacts to lead the current of electricity to and from the little machine.

A more powerful effect would be secured by using a hollow cylinder of iron instead of one constructed of copper, because the iron would prevent the straying of lines of force. The effects, either as a motor or a dynamo, will be still more powerful if the hollow cylinder be of the same length as that of the rotating field magnet. Wires would be connected to its top and its bottom for leading in the current, say, and one would be connected with the middle of its length for leading off the current.

The effects, either as an electric motor or as a unipolar dynamo, will be still more powerful, if instead of using a permanent field magnet we use an electromagnet. The coil of this electromagnet should not be wound on the core, but on a pasteboard tube which surrounds the core as closely as possible without actual contact. By mounting the exciting coil of the field magnet in this manner, we avoid the use of objectionable mercury cups or rubbing contacts for leading the electric current to and from the coil of the rotating field magnet. When used either as an electric motor or as a unipolar dynamo, the exciting coil of the field magnet may be connected either in shunt or in series with the hollow iron cylinder or stationary armature. Of course, in practical use, the axis of the machine would usually be horizontal instead of vertical.

A unipolar dynamo is one in no part of which the current of electricity is periodically reversed. There is a continuous cutting of the lines of force, and if the magnet be steadily driven, the current will be absolutely steady and uniform. Such a current is far more steady than that from a battery. The unipolarity in a unipolar dynamo is in the current, not in the magnet. There is no such thing as a unipolar magnet, or magnet having only one pole. A magnet of any kind has at least two poles. Perhaps some persons think that a unipolar dynamo is so called because, although the magnet has two poles, yet the dynamo will work with an armature near only one of its poles.

The guiding principle in the designing of unipolar dynamos, or direct-current motors without rubbing contacts, should be: Keep the armature stationary, and rotate the field magnet. It is well known that the core of an electromagnet of the straight type may be rotated while its exciting coil remains stationary.

In the unipolar dynamos and continuous current electric motors which I have herein described, the tension of the electric current will be low when used as unipolar dynamos, and low tension currents will be required when used as motors. The tension of the current will be about equal to that in other simple unipolar dynamos.

By abolishing all rubbing contacts in the manner proposed, we remove a great objection to unipolar dynamos. This objection is that there is much friction and wear of the numerous brushes required; the loss of power through friction is great; there is liability of heating at the rubbing contacts, as lubrication there is scarcely practicable. These difficulties are increased by the fact that the unipolar dynamo should be driven at a very high speed in order to get even a low electromotive force. Two volts are not consid-

ered an extremely low tension from the terminals of a unipolar dynamo. Such a current, however, may be of enormous quantity or amperage and may be quite suitable for electroplating and electric welding.

Such machines as I have herein proposed should prove to be very useful when used as electric motors supplied with electric currents from either primary or secondary batteries. This is because, when a motor is driven by a battery current, the battery is usually very near the motor, consequently the resistance of the connecting wires may be negligible. Such a motor as I have described having neither commutator nor rubbing contacts would be perfectly well adapted for driving automobiles, the battery cells being joined so as to give an electric current of very low voltage.

BUFFALO, N. Y. JAMES ASHER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Transformer-Rectifiers.—LEBLANC.—A long illustrated paper on the industrial applications of his combined transformers and rectifiers; the illustrations are quite poor and show very little, with one exception. His theories and methods were described in very long papers duly referred to in the Digest at the time, and the present paper merely describes the applications chiefly in the installations of the Northern Railroad of France. The object of his method is to transmit low tension continuous currents to great distances; the continuous current is transformed into an alternating one, has its voltage raised, is then transmitted, reduced and rectified in similar apparatus; the alternating currents are not regular waves but increase and diminish by steps. In the first installation made as early as 1893 the apparatus had an output of only 18-kw; the rectifier seems to be a synchronous motor having both a commutator and sets of slide rings, the latter to the number of 18; the current on the transmission line seems to be a current of 6000 volts; the alternating current seems to be transformed first into other alternating currents of 18 phases which are then rectified into a continuous current; the efficiency at full load including the line is said to have been 83 per cent. and the plant was working satisfactorily for several years until replaced by improved apparatus. In the later installation, the current is originally generated as an alternating current; the distance is 6 miles, the currents are diphase at 5000 volts and seem to be converted at the distant station into 12 currents of 12 phases, after which they are rectified, the final power being about 30-kw; the efficiency is said to vary from 72 to 84 per cent. for half and full charge respectively. The plant at Saint-Ouen has already been described; it is soon to be enlarged by the addition of an alternator of 1500-kw, the total power being then 2700-kw; in this plant there are also accumulators at the receiving end which are charged by the rectified current. Practice is said to have shown that no difficulties are involved in this method; numerous railroad stations on that railroad are provided with power in this way. Some new transformer-rectifiers of 100 to 35-kw are now under construction.—*Bul. Soc. Int. des Elec.*, June; abstracted in *L'Eclairage Elec.*, June 17.

POWER.

Switzerland.—GUILLAUME.—A long illustrated account of a tour made by electrical students; it is of interest as it contains descriptions, illustrations, tables, etc., concerning Swiss installations, and also some general remarks and a table giving columns of data of a descriptive nature concerning a large number of water-power stations in Switzerland; the report, being made by a capable engineer, is interesting reading. The following is some of the general information given. New alternating current stations generally use three-phase currents; there is no longer any fear concerning the disturbance of the balance due to unequal distribution on the three-phases; there is no hesitation even to overload one phase by putting all the lamps onto it. Continuous current also takes an important place; it is said to be used exclusively for the railways (which is not correct, as there are several three-phase railroads in Switzerland), and when used at high voltage on a series circuit, it has given good results. The increase in voltage is limited by the difficulties of the insulation of both the transformers and the line. The following statistics are given for 1898 for Switzerland: The number of large installations was only 3 and their total power 10,465-kw; but there were erected altogether 70 installations, 33 of which were for lighting, of which 23 used continuous current and 10 alternating currents; 23 for transmission of power of which 15 used the continuous, 1 the two-phase and 7 the three-phase currents; 14 for both lighting and power, of which 7 used the continuous and 7 the three-phase current; altogether 16,854-kw were installed; the highest voltage used is in the Kander plant at Thun where 3000-kw is transmitted at 16,000 volts. There is nothing particularly new in the generators; the tendency in motors is to use the high tension directly as much as possible; the most noted example is the 1000-hp motor recently installed using the two-phase current at 2500 volts and operating a pump forcing water to a height of 470 feet. As the "squirrel cage" motors use much current at starting, they are often prohibited above 4 or 5-hp when connected to central stations; the majority of motors therefore have movable coils. What is called an autotransformer for use in starting such motors is briefly described and illustrated; it has a self-induction coil which seems to be connected across the mains, while the motor to be started is connected between one of the mains and a connection which can be brought into contact with different windings of that coil; the e. m. f. of the portion not included in the motor circuit produces a current which is added to that in the other portion which flows through the motor; the action is like a transformer in which the ratio of transformation is varied during the starting of the motor. The illustrations of the generators, which are all rather small photographs, are chosen to illustrate the various types. A double page table states the conditions under which wires of various insulations or bare wires, may or may not be used.—*Bul. Soc. Int. des Elec.*, May.

Power from Windmills for Electric Lighting.—DICK.—A long illustrated account of the researches made by Wueste and Rupprecht (Austrian storage battery manufacturers) to utilize the power of the wind for electric lighting. As the velocity of the wind is most generally between 4 and 7-m per second, the windmotor is so constructed that the maximum speed is obtained for a velocity of 7-m, while for higher wind velocities, this speed is maintained constant by means of automatic devices. The power is stored up in two storage batteries, each of 36 cells. As far as possible the windmotors as well as the batteries are provided with automatic devices, which are described in full; they consist in their essential parts of iron cores movable in the solenoids, with two or three independent windings. A regular and successful installation constructed on these principles has been in operation for eight months.—*Zeit fuer. Elek.*, July 23 and 30.

Electric Installation for Feeding the Bourgoyne Canal.—GALLIOT.—An illustrated description of this installation for supplying the lower levels of the Bourgoyne Canal with the necessary quantity of water, which was difficult on account of the lack of water in the neighborhood. The water is taken from the Saone River and raised to the canal with the aid of pumps driven electrically, the water power of the Saone being utilized. Three-phase current of 7 to 8-amp. at 1800 to 2000 volts is transformed in three monocyclic transformers to 100 volts. The three motors used consume 3, 6 and 14-hp, their speeds being 800, 500 and 500 turns per minute respectively.—*L'Eclairage Elec.*, June 10.

REFERENCES.

Electric Power in Workshops.—MAYOR.—A discussion of the advantages, losses, etc. He believes electric power will never cost less than that obtained from gas engines, though for other considerations it is likely to be preferred. Direct current is considered to be decidedly superior to polyphase currents in factories.—*Mech. Eng.*, 3, p. 234; abstracted in *Science Abstracts*, August.

TRACTION

Three-Phase Railway in Switzerland.—A brief description of the Burgdorf-Thun Railway, which is the first railway for heavy traffic in Switzerland operated electrically, and which was briefly referred to in the Digest Aug. 19. Three-phase currents at 750 volts are used, two conductors being copper wires of 8-mm diameter, the rails forming the third one. The current is transmitted at 15,000 volts from the power station by overhead wires to 14 transformers along the line with a capacity of 450-kw. There are at present six motor cars, each weighing 32 tons, and having four motors of 55 to 60-hp each; they seat 66 passengers. Each motor car can draw an ordinary car having 55 to 70 seats, even on up grades. The speed is 36-km per hour. All cars are lighted electrically; the motor cars are heated by electricity, the other cars by steam and electricity. For freight traffic two electric locomotives are used, each drawing 100 tons even up the steepest grade of 25 per cent. The locomotives have two motors of 150-hp each, and can run at a speed of either 18 or 36-km per hour. Besides electricity, steam can be used as an auxiliary power for the traction, especially at times of heavy traffic.—*Elek. Zeit.*, Aug. 3.

English Electric Locomotives.—A short illustrated description of the electric locomotives which are in use on the City & South London Railway (see also McMahon's paper, abstracted in the Digest, June 3 and 10). Each locomotive is fitted with two motors, the armatures being built directly on the axles, and gives 150-lb. drawbar pull at 150-amp.; the maximum speed usually attained is 26 miles per hour. Each locomotive is wired for two complete lighting circuits, each consisting of five 16-cp lamps in series. The series-parallel controllers were specially designed by McMahon.—*St. R'y Rev.*, Aug. 15.

Experimental Trunk Railway.—A short note on an installation made by Siemens & Halske in Berlin where daily experiments are being made with a motor car drawing a train; the car looks like the ordinary steam railway car, but is somewhat shorter. The meager description states that the long vertical contact rod on the roof of the car, has three horizontal arms, one over the other, and takes current from three overhead wires, also one over the other; it is not clear what is meant and no further particulars are given.—*Elek. Anz.*, July 23.

Generation of Power for Electric Traction.—SCOTT.—In this continuation of his illustrated serial (Digest, Aug. 5), he discusses the conditions of the return line, as required by a provision of the English Board of Trade, and gives a description of a special panel of the switchboard, intended to show how these conditions are met; one of them, for instance, is, that the current passing from the earth connections through the indicator to the generator shall not at any time exceed either 2 amperes per mile of single tramway line, or 5 per cent. of the total current output of the station.—Lond. *Elec. Rev.*, Aug. 11.

Accumulators for Automobiles.—NORTHEY.—Some data, hints, prices, etc. He found that the Crowdus cell gave 10 watt-hours per pound of complete cell at a 4-hour rate, as against 7.6 for the best of the ordinary batteries. The cost of "maintenance" of a brougham for two persons and driver, traveling 11,000 miles per year, he states is $527 for horses and $337 with electricity (under maintenance he seems to include all the expenses). In the discussion, Oppermann stated that cellulose envelopes will not stand sulphuric acid for any length of time, also that if a battery costs $200 and lasts only two years, it would pay to use it on electric vehicles.—*Automotor Journal*, 3, p. 202; abstracted in *Science Abstracts*, August.

Magnets Instead of Springs for Trolley Poles.—HECKER.—In order to avoid striking the span wires when the trolley wheel leaves the wire, he proposes to dispense entirely with springs in the trolley base, and to substitute a coil and plunger mechanism through which the main current flows. If the trolley leaves its wire, the magnet loses its hold and the trolley pole falls where it can do no harm.—*Zeit. f. Elek.*, 5, p. 38; noticed in *Science Abstracts*, August.

REFERENCES.

Electric Traction.—GREATOREX.—A continuation of his article (Digest, Aug. 5) discussing some methods of rail-bonding, the feeders, the rolling stock and the cost of various systems.—Lond. *Elec. Eng*, Aug. 11.

Electric Traction in Europe.—JACQUIN.—A long illustrated article on electric traction in some large cities of Europe, especially London, Liverpool, Glasgow, Edinburgh, Vienna, Budapest, making comparisons with Paris.—*L'Eclairage Elec.*, June 10, 24.

Return Railway Feeders.—BOEHM-RAFFAY.—A continuation of the translation of his article, mentioned in the Digest, March 25 and Aug. 26.—Lond. *Elec. Rev.*, Aug. 11.

Working Expenses of Electric Cable Railways.—Details of the receipts and expenses of the Liverpool, the City & South London (both electrical) and the Glasgow cable line. The figures are favorable to the latter, showing the merit of cable haulage for heavy work.—*Railway World*, 8, p. 852; reprinted with the data in *Science Abstracts*, August.

Electric Railway Shop Hints.—Short illustrated descriptions of some tools and methods used in electric railway shops, such as an iron former for winding fields, special chucks for turning bearings and a method of bending pipes about a former. Some hints on car signs are added.—*St. R'y Rev.*, Aug. 15.

Snow Plows for Electric Railways.—An illustrated description of some snow plows and sweepers for electric railways, which can be used for either the overhead or the underground trolley.—*St. R'y Rev., Aug.* 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Stockholm.—An illustrated description of the municipal plant at Stockholm, Sweden, which when completed will have a capacity of about 2500-hp. At present there are installed 44.272 incandescent lamps of 2029-kw, 615 arc lamps of 287-kw, 199 motors of 446-kw. The three-wire system is used, with 110-volt continuous current, to the side. Two sizes of accumulators are used, the smaller being one-fifth as large as the others, and arranged in five parallel groups, while the large ones, which are in series with these groups, are used for regulating.—Lond. *Elec. Eng.*, Aug. 11.

Leith Electric Supply Plant.—An illustrated description of this municipal lighting plant. The current is furnished by five steam dynamos of together 428-kw output at 460 volts; it seems that the three-wire system is used, with high voltage lamps. The accumulator room contains 256 accumulators, having a capacity of 750 ampere hours at 100 amperes discharge. The street lighting consists of 74 arc lamps of the 10-ampere type, arranged nine in series between the outer conductors of the system.—Lond. *Elec.*, Aug. 11.

WIRES, WIRING AND CONDUITS.

Insulated Cables.—ZAPF.—A very long paper read before the Electrotechnical Society of Cologne, Germany, on the manufacture of insulated cables for low and high tension circuits, giving a very full description and many specific hints. Impregnated fibre is recommended as insulating material for circuits of less than 600 volts, and paper for higher voltages up to 6000 volts. For the lighting installation of the Kaiser Wilhelm Canal, on which 7500 volts are used, a combination of rubber and guttapercha is used, the results being very satisfactory. For higher voltages than 5000, rubber insulation is used in general. When testing cables, much higher voltages should be applied than those at which they have to be used; the 2000-volt cables of Cologne were tested at 5000 volts; those for the Kaiser Wilhelm Canal, for 7500 volts, were tested at 30,000 volts; several other cables were tested up to 50,000 volts. As a general rule for low and high tension cables, 500 and 1000 megohm per kilometer are required respectively, but this insulation is often exceeded. Telegraph and telephone cables are described and the use of paper as insulating material for telephone cables is discussed and recommended.—*Elek. Zeit.*, Aug. 10; *Elek. Anz.*, Aug. 6, 10.

Protection of Telephone Conductors Against High Voltage Circuits.—CANTER.—A short illustrated article recommending a slight modification of the device proposed by the General Electric Company of Berlin, which had proposed supplying each telephone wire at the insulators with eyes of wire connected with the earth, or, if there are a large number of telephone wires, to use, instead of the single eyes, a guard-wire under the telephone wires and perpendicular to them, so that if one of these is broken, it touches the guard eyes or wire, thereby connecting it with the earth, before it comes in contact with the high voltage circuit below it. He tested this device and found that a wire, if broken, vibrates greatly, and therefore does not always make contact with the guard device before it comes in contact with the high voltage circuit. To prevent this, he provided each telephone wire at a distance of 50-cm from the insulator, with a lead socket of at least 400-gr weight, such as is used for sound dampers, and then endeavored to find the most favorable position of the guard wire; he found that this has to cross the telephone wires within 17-cm from the insulators at a distance of 3-cm below them. Its ends are to be bent in the form of an upward hook.

He recommends galvanized iron wire of 5-mm diameter.—*Elek. Zeit.*, Aug. 10.

Diagrams of Overhead Wiring.—Two prizes, each of $15, are offered for the best drawings of overhead work at crossings or curves actually installed, first when all the overhead wires belong to the same company; and then if they belong to different companies, in which case it is necessary to insulate the different systems from each other.—*St. R'y Rev.*, Aug. 15.

REFERENCES.

Rules and Regulations.—A reprint in full of the set of rules and regulations for Germany, for pressures between 250 and 1000 volts, proposed by the committee appointed by the Union of German Electrical Engineers (see Digest, July 22). They have been adopted only tentatively, and are to be used at present only as a guide.—*Elek. Zeit.*, Aug. 10.

ELECTRO-PHYSICS AND MAGNETISM.

Electric Discharge Between Points and Plates.—PRECHT.—A repetition of Faraday's experiments on discharge in air between pointed and plate electrodes, using the alternative path method, with the point electrode positive in one of the gaps and negative in the other. He used four different influence machines and an induction coil obtained some remarkable differences; with the large machine the discharge was always between the positive point and the negative plate, but in the smaller machines it is almost entirely between the negative point and the positive plate, while with the induction coil it is the reverse. The results were confirmed by measurements of the difference of potential between the electrodes. The conclusion is that the differences can not be attributed to differences in positive and negative electrodes, but are due by the output of the generator and the magnitude and rate of variation of the potential at the electrodes.—*Wied. Ann.*, 66, p. 1014; noticed briefly in *Science Abstracts*, July.

Theory of Dielectrics.—BEAULARD.—An account of researches made to test some formulas of the theory of dielectrics. The theory of magnetic induction was founded by Poisson upon the conception of spherical particles of infinite permeability disseminated in a non-magnetic medium. Applying an analogous conception to the theory of dielectrics, Mossotti and Clausius gave a formula for the ratio between the inductive capacity of the dielectric as a whole and the inductive capacity of the suspending medium, as depending on the fraction of space occupied by the particles themselves. Betti gave a slightly different formula for the same ratio. Beaulard tested these two formulas by means of emulsions of copper in paraffine and found both very nearly verified, with a slight advantage in favor of Betti.—*Comptes Rendus*, July 17; abstracted in Lond. *Elec.*, Aug. 11.

Loss of Electrostatic Charges by Illumination.—KNOBLAUCH.—In a paper read before the German Electrochemical Society, he concludes from his researches that whenever a loss of electrostatic charges occurs by illumination, it is always a negative electrostatic charge which is dissipated, and that this dissipation seems always to be connected with an oxidation produced by the illumination. He gives the following explanation of these facts, founded on the theory of electric ions; by the oxidation, oxygen ions are formed which take negative electric charges and dissipate the electricity by traveling in the direction of the lines of force; as oxygen ions are able to take only negative charges, the negative charge alone can be dissipated. In the same way he explains the Hallwachs phenomenon, namely, that certain bodies, such as zinc, take a positive charge, if illuminated; the illumination produces oxidation and oxygen ions charged with negative electricity are dissipated into the air, leaving the zinc charged with positive electricity.—*Zeit. f. Electrochemie*, July 27.

Dielectric Polarization and Hysteresis.—SCHAUFELBERGER.—With ellipsoids of ebonite or paraffine suspended bifilarly between the vertical plates of a Kohlrausch condenser, he showed a considerably increased damping of the oscillations on charging the condenser; this means a certain expenditure of energy to keep the direction of polarization parallel to the electric lines of force and therefore necessitates a departure from Maxwell's fundamental formula connecting displacement with electric force.—*Wied. Ann.* 67, p. 367; noticed briefly in *Science Abstracts*, July.

Instantaneous Disappearance of the Kerr Effect.—ABRAHAM and LEMOINE.—An account of an exact investigation to measure the time which an isotropic medium needs to become doubly refracting under the influence of an electric field. A carbon bisulphide condenser is charged by a high-potential transformer; its own discharge spark furnishes the source of light for the beam passing between the condenser plates, and thus the illumination and the double refraction are simultaneous. A rapid succession of discharges is obtained by blowing across the spark gap. Double refraction is detected by the usual arrangement for observing elliptical polarization. Then a difference of time is introduced by sending the beam round a succession of mirrors before it enters the carbon bisulphide, and it is found that a path of 80 cm. is sufficient to annul the Kerr effect; this means a retardation of only one-four hundred millionth of a second.—*Comptes Rendus*, July 24; abstracted in Lond. *Elec.*, Aug. 11.

Nature of Gaseous Conduction.—BOUTY.—Descriptions of a simple test to find whether a body is a conductor or not, and its application to vacuum tubes. When an insulated body is brought between the plates of a condenser, a very decided increase of capacity is noticed when the body is a conductor; and it is quite immaterial whether the conductor is metallic or electrolytic. A vessel filled with gas at atmospheric pressure, also Crookes' tubes with high vacua, produce no difference in the capacity and thus show themselves to be non-conductors. An exception occurs in tubes with vacua of 1 to 5 mm.; at a certain difference of potential, they break down as insulators, and produce an increase of capacity of some 50 per cent., always lighting up at charge and discharge, when that happens. In a supplementary paper, he gives a formula for the relation between the voltage at which a gas becomes conducting and the pressure of the gas.—*Comptes Rendus*, July 17, 24; abstracted in Lond. *Elec.*, Aug. 11.

Absorption of Electric Waves.—BRANLY and LE BON.—An investigation of the screening action of some insulators and poor conductors such as are met with in practical work in wireless telegraphy. They used hollow blocks of cement, building stone and sand and found that the opacity depended much on their nature, condition and thickness. Sand and stone are very transparent, especially when dry; Portland cement is very opaque, wet sand almost equally so. —*Comptes Rendus*, 128, p. 879; abstracted in *Science Abstracts*, August.

Magnetic Decoherer.—TOMMASINA.—He made the important discovery that the presence of a magnet immediately destroys the conductivity of the coherer created by electromagnetic waves; he applied it to wireless telegraphy, substituting a magnet for the tapping device, the electromagnet being a few millimeters above the horizontal tube.—*Comptes Rendus*, 128, p. 1225; abstracted in *Science Abstracts*, August.

Velocity and Magnetic Deflection of Cathode Rays.—WIECHERT.—Descriptions of experiments in which the velocity of the charged particles constituting the cathode rays is determined by observations of their behavior in a rapidly alternating magnetic field. The velocity obtained is one-tenth to one-fifth of the velocity of light and a probable value of 1.0 to 1.5 multiplied by 10 to the eighth power, coulombs per gram, for the electric charge carried by them.—*Goettingen Nachrichten*, 3, p. 260; abstracted in *Science Abstracts*, August.

Diurnal Variations of the Disturbances in Polar Regions.—LUEDELING.—He shows that in polar regions the vector diagrams of the magnetic elements show a counter clockwise movement, if all days are considered, and a clockwise movement if quiet days alone are taken.—*Berl. Akad. Sitzber*, 14, p. 236; noticed briefly in *Science Abstracts*, August.

Magnetic Field of a Tubular Current.—DE NIKOLAIEVE.—A short description of an experiment showing the existence of a slight magnetic force inside a hollow cylinder, whose length is large in comparison with its cross-section, if a current traverses the cylinder along its length. The apparatus used consists of two concentric hollow tubes along which the current travels in opposite directions, the two tubes being suspended so as to be capable of rotation independently of each other. A magnet is half inserted into the inner cylinder, and also suspended so as to be capable of rotation about its magnetic axis. On sending a current through the two tubes in series, and connecting the inner tube rigidly with the magnet, the inner tube and magnet rotate in one sense and the other tube in the opposite sense, until the twist of the suspension balances the magnetic couple.—*Comptes Rendus*, July 24; abstracted in Lond. *Elec.*, Aug. 11.

REFERENCES.

Volume Changes Under High E. M. F.—MACHE.—He shows that gases change their volume when exposed to a strong electric force.

—*Wien Akad. Sitzber.*, 107, p. 708; abstracted in *Science Abstracts*, August.

Polarization Capacity of Reversible Electrodes.—Elsa Neumann.—A French translation of the article abstracted in the Digest, July 22.—*L'Eclairage Elec.*, June 3.

Strain and Thermoelectric Properties.—Maclean.—Experiments to determine the magnitude of thermoelectric effects in the same metal when one part is strained and the other is not.—*Roy. Soc. Proc.*, 64, p. 322; abstracted in *Science Abstracts*, August.

Photo-Electric Currents.—Schmidt.—Descriptions of experiments with cupric oxide which under the influence of light is transformed into cuprous oxide. He concludes that light is incapable of producing an e. m. f. at the surface of absolutely pure metals.—*Wied. Ann.*, 67, p. 563; abstracted in *Science Abstracts*, August.

Earth Currents in Germany.—Conclusions from observations made since 1881 to determine the strength, direction and duration of earth currents in Germany over a large area.—*Archiv. Post. Teleg.*, 4, p. 110; noticed in *Science Abstracts*, August.

Hysteresis.—Lyle.—A short, theoretical article on magnetic hysteresis, treating more especially of the calculation of the angle of hysteretic advance of phase.—Lond. *Elec.*, Aug. 11.

Magnetism in Ferro-Nickels.—Houllevigue.—A suggestion of a possible physical explanation of the existence at the same temperature, of magnetic and non-magnetic forms of the same ferro-nickel alloys.—*Jour. de Physique*, 8, p. 89; abstracted in *Science Abstracts*, August.

Electro-Chemistry and Batteries.

Aluminium.—Ditte and Moissan.—Four French Academy papers on the properties and applications of aluminium. In the first two, Ditte discusses the attacking of aluminium by many reagents; its apparent stability is due to a thin adhesive film of alumina, or of gas; when the solvent used is one capable of dissolving alumina, corrosion occurs rapidly, since the protective coating is being continually removed. In sea water, the carbonic acid of the air is the oxidizing agent. The film of alumina may retain particles of other salts, and if these impurities are allowed to remain in contact with the aluminium, the attack will continue slowly; to prevent this, it is necessary to wash the aluminium when taken from the water, with a solution capable of removing the last traces of alkaline matter from its surface. Certain alloys, consisting mostly of aluminium if maintained for a short time at a red heat, and then plunged into water, change in physical structure and become granular, the surface of the metal being found to be covered with fine cracks; a similar action is seen in the aluminium vessels used in the War Department.

Moissan points out that many results found by Ditte were due to the impurities in the aluminium used by him. Many of the vessels returned from the campaign in Madagascar were found to be practically unattacked. The principal advantages of the metal for military purposes, as compared with tinned iron, are lightness, no poisonous oxide, and the facility with which it may be stamped.

In his reply Ditte states that he has taken note of the impurities in the aluminium in his experiments; these remain on the surface of the metal when it is attacked, and by breaking the continuity of the layer of gases, they render the metal more liable to disintegration. He agrees with Moissan that each application of aluminium requires special and exact researches; he himself has recommended aluminium for the army, as the most suitable metal for water bottles.—*Comptes Rendus*, Jan. 23, March 27, April 10 and 17; abstracted at length in the Lond. *Elec. Rev.*, Aug. 11.

Statistics Concerning the Production of Lead, Copper and Aluminium in 1898.—A long abstract of the annual report of a metal society of Frankfurt, Germany. From 1896 to '98 the prices of lead and copper increased 14 per cent., of zinc 34 per cent., of tin 42 per cent.; in the first four months of 1899 the prices continued to increase. lead 9 per cent., copper 33 per cent., zinc 19 per cent. and tin 44 per cent. The increase in the production of lead was 34,000 tons in 1896, 24,000 tons in 1897, 81,000 tons in 1898; the increase in the United States was 16,500 tons in 1898, the whole production in the States being 196,900 tons, so that the United States now takes the first place in the lead producing countries, Spain being next with 179,000 tons. The increase in the production of copper was 43,000 tons in 1896, 23,000 tons in 1897, 11,000 tons in 1898. The United States also takes first place, producing 203,893 tons in 1896, 216,060 tons in 1897, 234,271 tons in 1898. The production of aluminium was 13,292-kg in 1885, 1,789,676-kg in 1896, 3,414,400-kg in 1897, 3,958,704-kg in 1898; the numbers for the United States are 589,676-kg in 1896, 1,814,400-kg in 1897, 2,358,704-kg in 1898. The price of aluminium was $250 per kg in 1855, $25 in 1886; in 1891 the price decreased from $3 to $1.25, until 1897 it decreased further to $0.60, and retained this value in 1898.—*Elek. Zeit.*, Aug. 3.

Electrolytic Extraction of Mercury.—Pulverized cinnabar is treated in a hot solution of sodium sulphide containing sodium hydrate; the vats are of iron, as are the cathodes; the anodes are sheet steel; the current density is 0.5 to 0.8 amp. per sq.dm.; voltage, 2. The mercury is recovered without difficulty and the electrolyte can be used again after the addition of sulphur.—*L'Ind. Electrochem.*, 3, p. 6; noticed briefly in *Science Abstracts*, August.

Chlorates.—Waubel.—By using a diaphragm and an anode solution of bicarbonate, he finds that all the chlorine carried in the anode chamber can be converted into chlorate. The electrolyte must be kept at 60 to 70° C., the current density 5 to 10 amp. per sq.dm. and the e. m. f. 4 to 5 volts; the solution of bicarbonate in the anode chamber and of the chloride in the cathode chamber should be saturated, and therefore fresh bicarbonate must be added from time to time. The efficiency is 951 watt hours for 88.14 grams of chlorate. The process has the advantage over some of the others that sodium hydrate is concurrently produced and can be recovered. At low temperatures hypochlorites can be produced.—*L'Ind. Electrochem.*, 3, p. 14; abstracted in *Science Abstracts*, August.

References.

Electrolytic Sodium Pertungstate.—Thomas.—He shows how sodium tungstate can be converted electrically into the para condition. Pertungstate of soda liberates ozone when heated.—*Industries and Iron*, 26; p. 327; abstracted in *Science Abstracts*, August.

E. M. F. of Concentration Cells.—Trevor.—He shows that this is proportional to the absolute temperature only when the heat of dilution from one concentration to the other is negligibly small, and if not, then the deviation from proportionality is determined by the form of the heat dilution as a function of the temperature and concentrations.—*Jour. Phys. Chem.*, 3, p. 95; abstracted in *Science Abstracts*, August.

Drop Electrodes.—Palmaer.—He shows that changes in concentration attending the contact between a metal and an electrolyte are evidenced by purely chemical means without closing an external circuit. His experiments confirm Nernst's theory of electrolytic solution pressure.—*Zeit. Phys. Chem.*, 28, p. 257; abstracted in *Science Abstracts*, August.

Conductivity of Nitric Acid.—Veley and Manley.—Determinations of very pure nitric acid.—*Phil. Trans.*, 191, p. 365; abstracted *Science Abstracts*, August.

Units, Measurements and Instruments.

References.

Long Scale Ampere and Volt Meters.—Davies.—A reprint in full with numerous illustrations, of the Physical Society paper abstracted in the Digest March 25. The chief feature of these instruments is that the movable rectangular coil rotates around one of its sides, whereby a very large range of deflections in a uniform field are obtained in a single air-gap.—*Phil. Mag.*, August.

Measuring Small Capacities.—Borgman and Petrowsky.—A description of a method using a Rhumkorff coil and a Geissler tube, by means of which capacities as small as a fraction of an electrostatic unit may be measured.—*Comptes Rendus*, 128, p. 420; abstracted briefly in *Science Abstracts*, July.

Wehnelt Interrupter with Alternating Currents.—Kallir and Eichberg.—An illustrated French translation in full of the article abstracted in the Digest May 13.—*L'Eclairage Elec.*, June 10.

Apparatus for Measuring the Light from Arc Lamps.—Laporte.—The complete paper, an abstract of which was noticed in the Digest, July 15.—*Bull. Soc. Int. des Elec.*, June.

Self-Winding Aron Meter.—Reyval.—A long illustrated description of the new form of the Aron meter.—*L'Eclairage Elec.*, June 10.

Telegraphy, Telephony and Signals.

Public Telephones in Berlin.—A well illustrated description of what are there termed "automatic" telephones, of which 100 have now been installed in semi-public places as post of telegraph offices, hotels, cigar stores, etc., and which are connected with the central telephone station. They are arranged to operate when the proper coin is inserted into a slot, and the central station operator can hear whether the coin has been inserted, before she makes the connections. The charge is 2.5 cents for an ordinary local three-minutes' conversation, or 5 cents for a connection with the suburbs. The arrangement is shown quite well in the illustrations. (The system is

not automatic in the sense in which the term is used in this country.) —*Elek. Zeit.*, Aug. 3; noticed very briefly in Lond. *Elec.*, Aug. 11.

REFERENCES.

Electric Block Signals.—KRIZIK.—A long illustrated description of his system of electric block signals, the mechanical movement being produced directly by electricity.—*Zeit. fuer Elek.*, July 16.

Telegraphy and Telephony.—A summary of the development of telegraphy and telephony from April to June.—*Elek. Anz.*, July 27.

MISCELLANEOUS.

Electrical Factory in Baden, Switzerland.—A short well illustrated description of the plant of Brown, Boveri & Co., which is called "the home of alternating current." The shops are without exception driven by two-phase induction motors, generally connected by belting to one or even two lines of shafting; a few of the larger machine tools are driven by individual motors. A water power a mile distant is used as a source. There are two turbine-driven two-phase 170-hp alternators generating current at 1000 volts, and two vertical shaft exciters, each driven by its own turbine. At the works the pressure is transformed down to 120 volts for the motors and 110 for the lamps.—Lond. *Elec.*, Aug. 11.

REFERENCES.

Electromedical Apparatus.—Brief illustrated descriptions of some apparatus made in Germany, including an antiseptic surgical apparatus, which can be connected directly to continuous current lighting circuits, an electric oven and an apparatus for heating gold for dentists.—*Elek. Anz.*, July 27.

Electrical Industry in Berlin.—Short reports of the following electric companies of Berlin as to their condition and development in 1898: General Electric Co., Berlin Electric Works, Union Electric Co., Schuckert & Co., Mix & Genest. They state that the year 1898 was a favorable one. The sales increased, while the profit on the individual articles diminished, on account of higher salaries and higher prices of the raw materials.—*Elek. Zeit.*, Aug. 10.

New Books.

THE LIFE STORY OF SIR CHARLES TILSTON BRIGHT, CIVIL ENGINEER. By Edward Brailsford Bright and Charles Bright. Two volumes, pp. 506 and 701. London: Archibald Constable & Co. Price, $10.00.

Sir Charles Bright, who, at the age of twenty-six, laid the first Atlantic cable, and thus gained fame as an electrical engineer when electrical engineers were few in any land and existed not at all in most, is the subject of a fascinating memoir, evidently a labor of love on the part of its authors, the brother and younger son of the subject. These two handsome volumes—well bound, beautifully printed, elaborately and interestingly illustrated and most thoroughly indexed—would grace any library. To the electrical engineer they naturally appeal with a special note of interest, as they contain a detailed record of a large proportion of the pioneer work of electrical engineering. The student and the beginner will find in these pages a strong incentive to an active and laborious career, for Sir Charles Bright accomplished all he did, and it was much, between the youthful twenties and the comparatively early age of fifty-five, when he untimely died at a period of life when professional men are usually considered to be in their prime and blessed with experience of untold value from which to advise those desirous of undertaking great works. In a leading article on the occasion of his death, *The Times* remarked: "If a man's life may be measured by the amount he has accomplished, Sir Charles Bright lived long, though dying at the comparatively early age of fifty-five. Few men have ever done more useful work for his country and for commerce in the short space of twenty-seven years."

The first volume is divided into five chapters, entitled Family Memoirs, Boyhood, Land Telegraphs, The Cable to Ireland, and The Atlantic Cable. In the early chapters the Bright ancestry is traced back to a colonel of horse in the rugged days of the Commonwealth. Possibly from such a descent came the strain of action that distinguished Sir Charles Bright in his engineering career, and, it may be said in parenthesis, also distinguished his son, the joint author of the biography, who is himself an energetic and industrious engineer and writer. In the chapter on land telegraphs is related, in Sir Charles Bright's own words, the famous incident of laying the underground telegraph lines through the streets of Manchester in a single night, a feat which Bright accomplished, as superintending engineer, before he had attained his majority.

The major part of the first volume of the memoir is taken up with an almost daily narrative of the first Atlantic cable project and expedition of 1857-8. Bright was one of the organizers of the project and chief engineer of the expedition. He laid the cable successfully and was knighted in recognition of his achievement. The never-palling story of the first Atlantic cable is most attractively told here, with a strong personal interest, and is very thoroughly illustrated by drawings and diagrams of the factories, ships and machinery employed.

The first volume concludes with a number of appendices of great interest, containing reports relating to the early telegraph work in the United Kingdom, and papers, articles and reports relating to submarine cables and particularly to the Atlantic cable. It is worth noting that the first telegraph lines built in England were laid underground. At the present time, after a long period when overhead work only was considered, engineers both in this country and in England are much occupied with underground lines of all kinds; in England, indeed, some of the long telegraph lines are now being put underground. So that the detailed records of Bright's work of over forty years ago have a curiously fresh interest at the present day and contain many a note and hint that will be useful to engineers who, owing to changed conditions, are going back to the paths of their forerunners.

The second volume contains 23 chapters and 27 appendices, which consist, like those in the first volume, chiefly of papers, reports and articles either by Bright himself or relating to his work. In this volume we get some very vivid pictures of the extraordinary difficulties that beset the early submarine cable expeditions. The laying of a deep sea cable to-day, or of a system of half a dozen of them, attracts no more attention that the building of a hundred-thousand-dollar bridge; indeed far less, as the work is beyond the observation of the general public or of the busy space-writer. But in the fifties and sixties the cable ship was by no means the well-constituted collection of powerful machinery that it is to-day; the Thomson wire-sounding machine was unheard of, and detailed surveys, such as have been made for most new cable lines during the past twenty years or so, were impossible; the raw materials for every part of a cable and its equipment fell many degrees short of the standards that have since been established, and, finally, engineers were fairly widely divided in their opinions as to the very type of cable suitable for different localities. In these circumstances—which are those that more or less surround every new industry of magnitude, but in the case of deep-sea cables were difficult to conquer in the precise proportion that the mysteries of the deep bear to those of the dry land—nothing carried through such enterprises as the Persian Gulf cables of 1863 and 1864, the Atlantic cables of 1865 and 1866, and the vast West Indian system of a few years later, but the indomitable grit, the patient resourcefulness and the engineering science and courage of such men as Bright, Canning, Webb, Thomson, Whitehouse, Brett, Clark, Clifford, Jenkin, Siemens, Laws, and a dozen other pioneers who laid down the broad lines of the work which have since been drawn so much finer and sharper by the light of experience and invention.

Of Sir Charles Bright's share in the adventurous and arduous work of those far away pioneer days we get a vivid picture in the second volume of the biography. In 1860 Bright laid an important series of cables between Spain and the Balearic Isles, consisting of four sections of a total length of 365 nautical miles. Although the sections were short—the longest, that between Barcelona and Port Mahon, being only 180 miles—the water was very deep, reaching 1400 fathoms in some parts. Bright completed this work in less than a month after arriving on the ground. Much of the laying was done during heavy weather, but no serious accident happened, although once, at about two in the morning, in 1300 fathoms of water, the brakesman in charge of the paying-out drum was discovered asleep at his post. This successful expedition broke the spell of bad luck

that had hung over cable laying in the deep blue waters of the Mediterranean.

After this we get a splendid narrative of the laying of the Persian Gulf cables of 1863-64, carried out by Sir Charles Bright and Mr. F. C. Webb. These cables formed part of the first telegraph system between England and India. The cables ran from Fao, at the head of the Persian Gulf (famous in submarine cable circles as the hottest place on earth), to Karachi, touching at several points on the Persian coast. The total length of cable laid was 1148 nautical miles. At Fao connection was made with a land line running through Persia and Turkey, built specially for the Indo-European line, and at Karachi with a land line to Bombay. This was the first real cable expedition of magnitude sent out to far distant parts and carried to a successful conclusion. The work was done, and done well, in spite of innumerable difficulties. The cables were laid down in perfect electrical and mechanical condition and worked with greater regularity and at a higher rate of speed from the very beginning than any previous system of cables. Unfortunately for the success of the whole scheme of the Indo-European telegraph, the Turkish land line was a hopeless failure. The Turk of thirty-five years ago was not less Turkish than he is to-day—apathetic, incurious, jealous of foreign assistance and altogether hopeless as a link in any sort of a chain. Those who were interested in rapid communication between England and India had for years to grind their teeth in rage at the exasperating spectacle of land lines down for days and weeks at a time for want of a few hours' work in repairs, of messages delayed while the lazy Turk dozed and smoked away the precious hours, of words mangled beyond recognition by pure brute malevolent carelessness, and of all the other deviltries with which Mohammedan fatalism delights to clog the orderly working of Christian science. The Turk was eventually cut out by the Red Sea and Indian Ocean cables, and left to wallow in his telegraphic unspeakableness.

The *pièce de résistance* of the second volume is the story of the West Indian expedition, which occupied several years of Sir Charles Bright's life, interrupted his Parliamentary career, and broke his health. Here, by the aid of Bright's own diary and letters, we get a most realistic view of the trials of cable-laying under the hardest conditions. Bright was the heart, soul and brains, promoter, financier and engineer of the great West Indian system of cables. The original scheme called for no less than 13,000 miles of cable, and all of this and much more has since been laid in those treacherous and inhospitable waters. Bright planned out the whole system, got concessions, procured subsidies, raised capital, bought and fitted out a cable ship—the famous Dacia, veteran, but still an active one, among telegraph steamers—and laid some four thousand miles of cable. This work was carried out under disheartening conditions that would have wrecked a less stout spirit. Cables broke, and weeks and months were spent in weary dragging over a rocky bottom two miles below that chewed up grapnels by the score and silently yawned for more; faults developed on board, and many burning days had to be spent in turning over miles and miles of close-coiled cable to cut them out; ships went aground; crews insisted on being paid off and allowed to go home. Finally, the dreaded yellow fever struck the expedition, and man after man succumbed. A seaman, a cable hand, a jointer or an engineer was buried at sea or from the hospitals on shore as each melancholy day came round.

To those who had such lively work last year during the Cuban campaign in cutting some of these very cables the story of the many difficulties Sir Charles Bright met with in laying them will have a very close and personal interest. The expedition, however, which lasted several years, was not without its bright spots to relieve the gloomy stress and strain that made it such a strenuous undertaking. There is many a cheerful picture of the joy and festivities with which the people of the various beautiful towns of the West Indies greeted those engaged in putting them in close touch with the outer world.

This was Sir Charles Bright's last cable expedition. The malarial fever which nearly carried him off in the West Indies more or less affected his health during the rest of his life, and was responsible for his early death. For some years after his return from the West Indies, Bright was engaged in working some lead mines in Servia. He had always a predilection for mining, and at various times in his career was engaged in mining enterprises. Unfortunately, they were usually disastrous, and much of the money made by sinking cables at the bottom of the sea was, in its turn, sunk in the earth and proved, unlike the cables, not only unproductive, but irrecoverable. Of the many other occupations to which Sir Charles Bright turned in the later years of his life the reader must learn from the book itself.

The chief of a cable expedition must have many qualifications, inborn and acquired. He must be a good organizer and commander; he must be a marine engineer, a navigator, a civil engineer and an electrician all in one; a bit of a diplomat and something of a linguist; and, finally, he must be something of an inventor and man of resources, able to meet new conditions with new means of coping with them. Sir Charles Bright was a many-sided man, and had all of these qualifications and some others. He was a prolific and ingenious inventor, and many of the devices he originated have become standard in the equipment of land and submarine telegraphs. He was a bit of an artist, an enthusiastic sportsman, and a charming and jovial companion, as hosts of friends and shipmates who still mourn him will testify.

The book is a very human document. It is at once a book of travel and adventure, a record of active and earnest achievement, a history of the youth of a mighty scientific industry, and a mine of information on the technical features of early electrical engineering. The authors have largely let Sir Charles Bright tell his own story through extracts from his diaries and from his letters home. They have added many a personal touch of interest and many a reference of value giving additional information regarding the subject of the text. They have illustrated the book with illustrations that really illustrate, sketches of cable operations, drawings of machinery, photographs of Bright's colleagues and diagrams of his inventions. Every electrical engineer who has difficulties to overcome himself will find encouragement and suggestion in reading how Bright and his co-workers overcame theirs, while every telegraph man will find in Bright's biography a record of both the human and the scientific sides of land and sea telegraphy that will do his heart and his brain good to read.

The book is beautifully printed and bound, as we have already said, and is indexed with such scrupulous care that even Sir Charles Bright's fondness for pickles is not overlooked in the copious list of references.

H. L. W.

BOOKS RECEIVED.

ELECTRIC MOTIVE POWER. The Transmission and Distribution of Electric Power by Continuous and Alternate Currents. By Albion T. Snell. Second edition. New York: The D. Van Nostrand Company. 410 pages, 224 diagrams and illustrations. Price, $5.00.

THE MOTOR ENGINEERS' AND ELECTRICAL WORKERS' HANDBOOK. Published by William Lintern. Cleveland: Blumberg Printing Company. 150 pages, numerous diagrams. 6¾x3½.

ELECTRICIANS' MANUAL OF DIAGRAMS. By E. W. Smith. Philadelphia: Scientific Publishing Company, of Pennsylvania. 93 pages, 45 plates. 5¼x3¼ oblong.

HEAT AND HEAT ENGINES. A Study of the Principles which Underlie the Mechanical Engineering of a Power Plant. By Frederick Remsen Hutton, E.M., Ph.D. New York: John Wiley & Sons. 553 pages, 198 illustrations. Price, $5.00.

Test of Small Current Meters.

Dr. Emil Heuel, 350 Willis avenue, New York City, chairman of the American Electro-Therapeutic Association's Committee on Meters, writes us as follows: During the month of September, 1899, the ninth annual meeting of the American Electro-Therapeutic Association will be held in the City of Washington, D. C. As chairman of the Committee on Meters, I have been requested to make a test of the various electrical and electro-medical instruments of precision and measurement. This test will be conducted by myself and associates, gentlemen of recognized ability and standing in the electrical and medical professions. It will be an impartial and comparative test of the various merits claimed. A general description will be given in our "Annual Report of the Proceedings of the Association." The test will include instruments for measuring the amount and direction of the Direct or Constant, Indirect, Interrupted or Sinusoidal and the Faradic or Induced Currents, the Resistance, etc., e. g., Voltmeter, Ampere-Meter, Mille-ampere-meter, Wattmeter, Ohm-meter, Farado-meter, Galvanometer, Wheatstone Bridges, etc.

It is desirable that manufacturers submit a short but detailed statement of the various merits and points of superiority claimed for their various instruments. This to be embodied in our report.

All the instruments are to be sent expressage prepaid, properly packed, at the owners' risk, to my office, by not later than Wednesday, Sept. 13, 1899, and will be so returned.

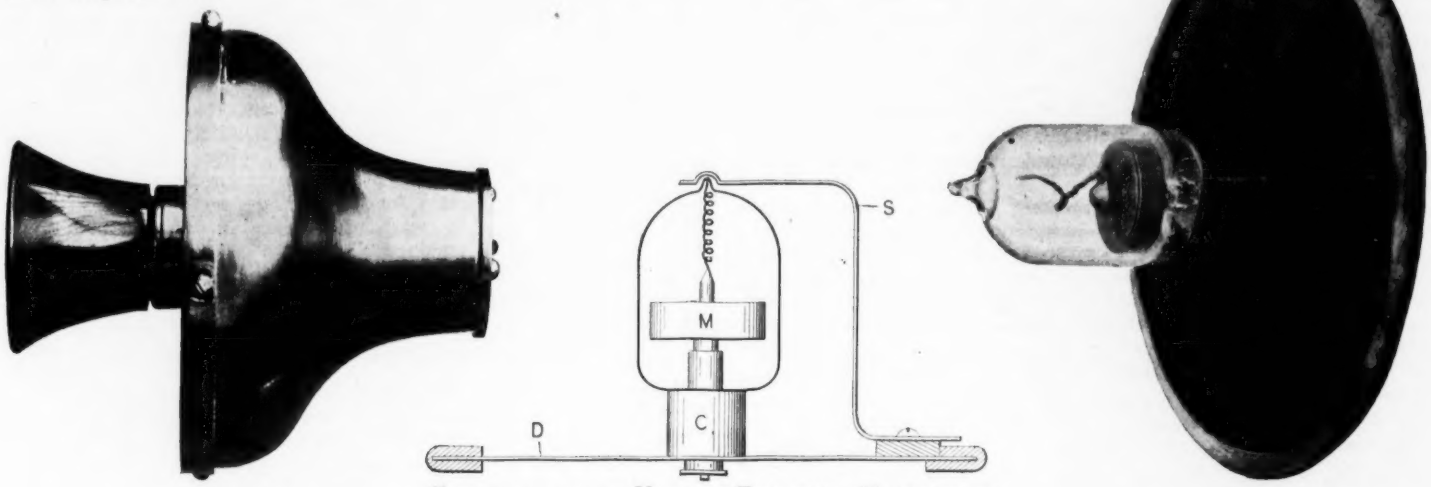
Vacuum Telephone Transmitter.

BY PAUL KILDUCHEVSKY.

The invention of a transmitter which will enable clear, articulate telephonic communication to be established over longer distances than have heretofore been possible by existing telephones, has for several years engaged my attention, and the result is the transmitter shown in the accompanying illustrations.

The invention comprises an improved microphone transmitter whereby the use of powerful currents is rendered possible without risk or injury to the microphone, which, moreover, is completely protected from external causes by which its efficiency might be impaired. Any kind of microphone may be employed; that is to say, the carbon or other substance may either be granular or in the form of pencils. The essential feature is that each microphone is enclosed in vacuo or in an inert atmosphere in a hollow body.

The vacuum bulb, as will be seen (Fig. 3), is attached bodily to the transmitter diaphragm, *D*. In this illustration, *M* is the microphone, *C* a collar, and *S* a spring. As is the case with the filaments of an incandescent lamp, the exclusion of air enables larger currents to be used than would otherwise be possible without the combustion of the carbon; and the advantages (especially for long distance or loud speaking work) of a powerful transmitter, through which large currents can be sent without clogging the instrument, are well known to all telephone men.



FIGS. 1, 2 AND 3.—VACUUM TELEPHONE TRANSMITTER.

Every detail in the transmitter has been carefully thought out, and it is believed that this new instrument is a great advance on any other kind of telephonic transmitters. It must be understood that the transmitter can be used with ordinary cells, viz.: from one dry cell and upwards, and not only over long distances, but on ordinary town and private lines. If necessary the current may be increased to any extent without risk of injuring the instrument. The technical advantages of the transmitter may be resumed as follows:

1. Strong currents can be used. 2. The microphone is protected from moisture and dust; and packing of granular type cannot occur. 3. The speech is loud and distinct. 4. The transmitter is simple in construction. 5. It does not burn or get out of order. 6. It is the most powerful transmitter in the world. 7. It can be used in places where other transmitters will not work.

As to commercial advantages, the following may be enumerated: 1. The cost of the transmitter is the same as that of an incandescent lamp, so that it can be sold at a low price. 2. As the transmitter will work where no other can, it has a larger field than any other type. It can be used with advantage on board ship, in diving apparatus, in factories and noisy places, on railways, in mines, submarine cables, for trunk lines and public call offices, for military service, fire brigade, and in all places where telephones are now used.

Power in a Modern Factory in Chicago.

An interesting example of electric power delivered from central station service is found in the new factory of Messrs. Bauer & Black, on the southeast corner of 25th Street and Armour Avenue, Chicago. This is a modern three-story fireproof building erected last spring for the manufacture of patent plasters, chest protectors, etc. Electricity is used throughout, the service providing for about forty-three Bergmann lamps, and thirty-five 220-volt Crocker-Wheeler motors amounting to over 100-hp. The entire electrical work, including motors, arc and incandescent lamps and wiring in iron armored conduit, was installed by the Chicago Edison Company, from whose mains the current is supplied for operating the plant.

On the third floor there are located about eighty sewing machines run on two shafts geared to two 2-hp. motors, seven printing presses each operated by an independent motor, and a fan and a churn operated by a 1-hp. motor. The second floor is used for an office and for other purposes, and is well lighted throughout with arc and incandescent lamps. On the first floor there are two classes of machinery, the one used in the manufacture of porous plasters, and the other for making absorbent cotton. These are all driven by motors either belted or geared direct to the various machines.

Throughout the entire factory there are no countershafts, with the single exception of the shaft running under the sewing machine tables. In the basement the elevator and the pump are also run by electricity, so that steam is used for heating purposes only. Although the plant has been in operation only about four months, the results thus far have been very satisfactory to the owners, the amount of current used corresponding very closely to the original estimates.

Electrical Engineering at Drexel Institute.

The course of instruction at this well-known Philadelphia technical school is organized so that the practical and commercial side of engineering is made especially prominent, pure theory being always studied in connection with its practical application. Study may be begun at a grade equivalent to that necessary to enter high or manual training schools, and the electrical engineering course is completed a year sooner than is required for a similar one in a college or university. The laboratories are well equipped with machinery and instruments selected to make it possible to study the types in regular commercial use and to make all the measurements usual in shops and testing rooms. The most recent equipment is of two and three-phase apparatus (motors and rotary converter) in sizes large enough to illustrate real engineering practice. There are, in addition to the day courses just described, evening classes in applied electricity organized along two lines. One of the courses is for the machinist, electrical artisan, or salesman who wants to increase his familiarity with electrical matters, but who does not want to make more than a simple study of scientific or mathematical subjects. The other is a course of advanced grade for evening students, intended to meet the needs of mechanical engineers, high and manual training school graduates, who have not other time for study at their disposal. Studies preliminary to and leading up to this work are given in the evening. The same laboratory facilities are used and the instruction is by the same teachers as in the regular engineering course of the day classes. The work of both day and evening classes is in charge of Prof. Arthur J. Rowland.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET witnessed a rather dull and somewhat irregular market, but there was on the whole a most gratifying exhibition of strength. One could hardly expect to see a market otherwise than firm, to say the least, when the railroads were reported the heaviest gross earnings and biggest net, in their existence. Railroad stocks may be high at present dividend rates, but any increase in their return to stockholders—and such may be expected—will do much to keep their prices stiff and strong, quite aside for further pushing of plans for concentration of management and consolidation of systems. Electrical stocks generally are in good shape. American Bell in Boston is "way up," in spite of the prospects of shifting to New York as a base; perhaps because of that. Western Union is curiously weak, but is said to reflect the country's prosperity in its income. General Electric and Westinghouse are both strong on enormous business and new contracts galore. In the traction stocks the feature was Brooklyn Rapid Transit. After an early advance, caused by large inside buying, which induced considerable covering, the stock was again raided by the bears, whose principal arguments against the stock were anonymous circulars attacking the company, and reports that the Standard Oil interests were no longer interested in the property. This latter report was put out with a great deal of assurance, but at least one prominent Standard Oil interest was found which denied the report. Alleged deals between New York Metropolitan and Manhattan Elevated are denied with much emphasis. During the week, on sales of 6,970 shares, Western Union closed at 88¾. General Electric on 1006 shares, moved up 1 to 125. Brooklyn Rapid Transit closed at 104¼ on sales of 251,035 shares. Metropolitan Street Railway on 16,019 shares, closed at 206, and Manhattan, on 42,675, at 113½. In Boston, American Bell Telephone closed at 364, New England Telephone at 155, Mexican 6½, Boston Elevated 109⅞, West End 95¼, preferred 114. In Philadelphia, Penn Mfg. Co. was 28¾ bid, National Electric 12⅝, Philadelphia Traction 99⅜, Union Traction 41½, Electric Storage Battery 145 common and 150 preferred, Electric Co. of America 20⅛ bid. In Chicago, Union Traction was quoted at 36¼ common, 87 preferred; other stocks dull. In the New York outside securities lack of support was responsible for the weakness in the transportation stocks. New York Transportation sold at 25 early in the week, but declined steadily to 21⅞, and closed at 21½ bid. Illinois declined ¾ point to 4½ on light trading. New England advanced to 10¼, but lost some of the improvement, closing at 9⅞ bid. Electric Vehicle was quiet and the price ranged between 105 and 110. Electro Pneumatic was weak, declining from 2½ to 1¾. Electric Boat common went off from 24 to 16 and preferred from 46 to 40. Denver Gas and Electric 5s were strong, sales of $10,000 being reported at 89⅞.

TELEGRAPH AND TELEPHONE.—The chief reason given for the recent weakness in the quotations of Western Union stock has been the effect of telephone competition on its income. Such an excuse smacks of stock jobbing devices, for there is nothing in the present condition of the two arts of telephony and telegraphy to justify a pessimistic bear raid on what is one of the great earning industrial properties. The truth is well set forth by a well-informed contributor to the New York *Evening Post*, who says: "It is not believed that the telephone will ever drive out the telegraph. There are occasions when a man with any amount of money to spend would prefer the telegraph to the telephone. The telegraph leaves a positive record at each end of the line. One writes out his message on a telegraph blank, and leaves it with the clerk, and the matter is off his mind; he is not compelled to lie around and wait on busy wires. He can go after any other business he may have. To be sure, his message may be delayed by telegraph, but his time will not be wasted. Another point of advantage is the superior accuracy of the telegraph in the transmission of any message involving figures. In reading figures over the telephone there is a large percentage of probability of error. A greater block of news will always be transmitted and diffused over the country by telegraph for these reasons: An operator, sitting in New York with a single key, can by telegraph send his message to as many cities in the United States as he pleases, by the use of the telegraph repeater. There is no telephone repeater, and there is none in sight. No town is too small for a telegraph office. In many of these towns it would not be profitable to have even a single telephone, much less to have a telephone exchange." One of the great advances of our times has been the use of the telephone, but this beautiful invention has largely created its own field, and has still much to do in linking together remote sections of the country, isolated farms, scattered mines, and people who would otherwise be beyond quick communication. But after people have thus been brought into touch, the telegraph remains in its own field and may yet have its functions enormously developed by cutting into the domain still served by the mail, in the manner indicated by Delany and others.

ANALYSIS OF THE METROPOLITAN STREET RAILWAY REPORT.—The Metropolitan Street Railway Company, supplementing its annual report, whose figures were noted in these pages last week, has just issued a comparative financial exhibit showing the relative costs and profits in detail of the operation of the cable lines, the electric lines, and horse railway lines for the fiscal years ended June 30, 1898, and June 30, 1899, respectively. The company, on June 30, 1899, had 253 miles of track in operation by the cable system, the construction dating from 1893 and 1895; 82.1 miles of track operated with the underground electric system, nearly all of which was opened from Nov. 1, 1897, to Oct. 1, 1898, and 113.4 miles of horse railway track. In the last year the company ran its cars over the same trackage nearly 42,000,000 miles, as against but 35,000,000 miles in the previous year, the new cars, moreover, being nearly double the capacity of the old. The passenger receipts increased nearly 25 per cent. as a consequence, while the receipts per car mile were actually increased from 29.7 cents to 30.7 cents, or about 3 per cent. The traffic of the cable lines fell off about 10 per cent. and of the horse lines about 30 per cent., while the electric lines carried three times as many passengers in 1899 as in 1898, and their receipts per car mile increased from 26.99 cents to 31.23 cents. Taken as a whole, the tables show that the Metropolitan system operated last year at 15.18 cents per car mile, as against 15.83 cents in the previous year, and the earnings from operation have become 15.50 cents, as against 13.87 cents for 1898. The electric lines are shown to have made all of this increased net earning power, and have in addition overcome a combined diminution on the horse and cable lines of 1.15 cents per car mile. The percentages of operating expenses to passenger receipts of the three motive powers compare as follows:

	1898. Per Ct.	1899. Per Ct.
Cable	47.8	50.8
Electric	37.9	38.3
Horse	65.3	69.8
Total	53.3	49.4

FINANCING A TUNNEL RAILWAY.—A great financial question now coming before the New York public is the proposed tunnel electric railway, work on which is now nearer than ever. A great many points arise, but the city officials intimate that Greater New York can spend fifty to sixty millions without overstepping the constitutional debt limit. It is not to be forgotten that, at present prices, the cost will be considerably higher than if the work had been done in the dull times. A prominent contractor said this week that he believed that it would be difficult to get contractors to bid for the job, because of the immense amount of capital needed. This had been added to largely by the enormous advance in iron and steel, and the enactment of the new labor law. "The advance in iron and steel will make the tunnel cost $5,000,000 more than the original estimate, while a like sum will be added by the new labor law," he said. It was said a day or two ago that Mr. William C. Whitney, who recently returned from abroad, had succeeded in raising capital in Europe, so that the Metropolitan Street Railway Company can bid for the construction of the tunnel, and that this is the secret of Tammany's change of front. In this case, it was said, the company would bid for the privileges of operating the road for fifty years, as it may do under the law. H. H. Vreeland, the president of the Metropolitan Company, declined to discuss this report. The moment the Corporation Counsel approves the form of contract the Rapid Transit Commission assumes control of the matter. It was stated that the Municipal Assembly cannot hold up the necessary bond issues, as under the recent decision of Justice McAdam the Rapid Transit act makes it mandatory for the proper authorities to issue bonds, and that this decision would then extend to the Board of Estimate.

NEW ENGLAND ELECTRIC VEHICLES.—Since July 1 the New England Electric Vehicle Transportation Company has had in operation at Newport thirty open vehicles which have been leased for $150 each per month. These vehicles have for the past two months contributed earnings of $9000. The company has had five cabs in operation in the City of Boston since May and from May 15 to Aug. 28 they have carried 1820 passengers, have traveled 5605½ miles;

each cab an average of 14.91 miles per day and earning on an average $10 per day per cab. This would give earnings of $5250. This earning capacity, per cab, should not be so large with 100 or more cabs in commission. The company still has $1,500,000 of stock of the $25,000,000, in its treasury. It received $2,350,000 cash from its stock issue and of this amount $165,000 was paid for the Cyclorama building on Tremont street, which when completed will have accommodations for 600 vehicles and will cost about $250,000. The company should have 100 cabs and 100 delivery wagons in service by the end of this year. It is now, with the Newport season over, concentrating its energies on the Boston service.

FUTURE OF ERIE TELEPHONE.—The Erie Telephone and Telegraph Company serves 90,000 subscribers and the minority interest owned by the American Bell Company in the sub-companies is not sufficient to permit it to dictate the policy of the company. The plan of the American Bell to control all sub-companies cannot be carried into effect unless they own 25,001 shares of the Erie stock. In order to secure this large amount of stock the price would undoubtedly be carried much higher. The capital stock now is in the hands of 1900 stockholders, and there is not much doubt that the dividend following the one to be declared in October will be at the rate of 5 per cent. per annum. The earnings of the company for the past six months indicate between 7 and 8 per cent. for the year 1899. With this excellent showing the stockholders will be slow to part with their holdings under $150 per share. Should the controlling interest pass into the hands of the Bell Company it is given out that no change whatever would be made in the management of the company as the Bell people are in full sympathy with the progressive policy of the managers.

MASSACHUSETTS ELECTRIC COMPANIES.—The recent advance in the preferred stock of the Massachusetts Electric Companies from 7 to 82½ has been the result of investment buying. The advance in the common stock has been in sympathy with the preferred. It is estimated by the management that the gross earnings of the constituent companies for the year ended Sept. 30 will show an increase of $400,000, four months of which time the roads have been in their hands. Of the $400,000 gross increase in earnings at least 50 per cent. is net, but is being spent in improvements. The value of these improvements will be demonstrated next year; in fact, General Manager Sullivan says he will surprise stockholders with the result of concentrated operation and management after the roads have been under one management six months.

AMERICAN BELL TELEPHONE.—New York has been the largest buyer of Bell Telephone stock of late. Nearly everybody in New England is now awakening to what the *Boston News Bureau* announced last year, viz., that the granger legislation of Massachusetts would result in driving out of the State the American Bell Telephone Co., the greatest corporation within its borders, and having a future second to none in the United States. The transfer of securities from the American Bell Telephone Co. treasury to the treasury of the American Telephone & Telegraph Co. of New York (the Bell Co.'s Long Distance company) has been going on, as we announced some time ago, and now New York is strengthening its ownership by purchase of the Bell shares in the Boston market.

CONSOLIDATION IN SEATTLE.—Three of the principal street railway lines in Seattle, Wash., have become the property of a Boston syndicate headed by Stone & Webster, and a fourth road will be transferred to the same firm in a few days. The purchase price for the four lines is about $2,500,000. This is part of the general consolidation scheme. The three lines actually sold are the Seattle Traction Company, owned by N. W. Harris & Co., of Chicago; the Union Trunk Line, owned by Massachusetts capitalists, and the West Street Electric Railroad. The Madison Street cable road will be transferred as soon as minor matters can be arranged.

CHICAGO UNION LOOP.—The Union Loop directors declared a dividend of $4 per share out of the earnings of the company, payable immediately to stockholders of record Aug. 25. In some quarters a dividend was expected, but even those who predicted its disbursement would be ordered at the meeting looked for no more than a quarterly dividend of 1 per cent. The Loop benefits by the development of South Side Elevated traffic under the use of the Sprague multiple unit system.

STATEN ISLAND.—Application was made by the Staten Island Rapid Transit Company to the State Railroad Commission last week for permission to issue $2,500,000 worth of second mortgage bonds. The application not conforming to the rules and regulations of the board, action was postponed.

THE STANDARD ELECTRIC COMPANY, of San Francisco, is to issue $5,000,000 5 per cent. 50-year bonds to build its plant for power transmission. We understand that the Sprague Company has the contract for 25,000-hp of apparatus. The distance of transmission is about 150 miles.

Commercial Intelligence.

THE STATE OF TRADE.—The present outlook in the electrical trade is cheering and satisfactory. A large amount of new business is offering, and the better prices asked and given are due in no small measure to the fact that the shops where orders must be executed are already full to overflowing with work. Moreover, while iron and steel show no abatement in price, there is some prospect that copper will go no higher and may decline from its present figure, at which the margin of profit is excessive. General trade conditions, domestic and export, are excellent. *Dun's Review*, speaking of the situation generally, says that the astonishing feature is the magnitude of demand, notwithstanding prices which would ordinarily check it. In products directly consumed by individuals, the larger employment and better wages of the working force give explanation. Efforts to meet the demand call for more stores, manufacturing works and machinery and facilities for transportation. The occasion promises quick profits, the building is largely for the future, and it goes on in spite of unusual prices. *Bradstreet's* notes that with an exceptionally heavy business already booked for the latter portion of the year, the mercantile community faces the trade situation with confidence, testified to by very generally firm prices and with quotations in a number of lines showing further marked advances. Bank clearings at seventy-six cities for August, telegraphed to *Bradstreet's*, show an aggregate of $6,896,463,443, a total smaller, as was to be expected, than for any preceding month this year, but larger by 23.4 per cent. than those of August a year ago, in which month very large increases first began to be noted, 43.4 per cent. larger than those of August, 1897, 95 per cent. in excess of August, 1894, and 50 per cent. larger than those of the same month in 1892. For the eight months of 1898 the clearings at seventy-six cities aggregate $62,050,949,254, a total of 42 per cent. in excess of last year, within $7,000,000,000 of the total for the entire year 1898, and larger than those of the calendar year 1892. Business failures for the week are the smallest reported for a long time, numbering only 131, as compared with 154 last week, 164 in this week a year ago, 198 in 1897, 336 in 1896, and 184 in 1895. As to newer electrical work, a large demand for apparatus is noted in the items below, while an intended $1,000,000 power house for the United Railways Company is reported from St. Louis, Mo.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following exports of electrical material are from the port of New York, for the week ending Sept. 2: Antwerp—39 packages electrical material, $1875. Argentine Republic—51 cases electrical machinery, $1830; 43 cases electrical material, $1536. Alexandria—4 packages electrical material, $534; 5 cases electrical machinery, $1271. Aden—4 cases electrical material, $172. Berlin—19 packages electrical material, $1027. British West Indies—38 packages electrical material, $1032. British East Indies—1 case electrical material, $80. British Guiana—14 cases electrical material, $300. British Possessions in Africa—115 packages electrical material, $4415. Central America—9 packages electrical material, $104. Cuba—15 cases electrical machinery, $484; 34 cases electrical material, $1034; 3 cases electric light plant, $508. Genoa—2 cases electrical material, $5. Glasgow—83 packages electric motors, $6550; 4 packages electrical material, $172. Hamburg—19 packages electrical material, $625; 38 packages electric material, $3533. Japan—9 packages electric material, $758; 9 cases electrical machinery, $983. Liverpool—6 cases electrical machinery, $267; 77 cases electric material, $3819; 1 case electrical machinery, $50. Mexico—17 packages electrical material, $14,863; 4 cases electric machinery, $582; 6 cases electrical material, $320; 12 cases electrical material, $500. Marseilles—4 cases electrical material, $282. Newfoundland—1 package electrical material, $28. Piræus—3 cases electrical material, $45. Rotterdam—2 packages electrical material, $65. Swansea—40 cases electrical material, $800. Southampton—47 electrical material, $2040; 36 packages electric machinery, $238. Siam—49 packages electrical material, $884. Trieste—9 packages electrical material, $238. U. S. Colombia—11 packages electrical material, $304. Uruguay—1 case electrical material, $8. Zurich—1 case electric tape, $75.

APPARATUS FOR SWITZERLAND.—Mr. Angus Sinclair, president and editor of *Locomotive Engineering*, has received particulars from Switzerland in regard to a syndicate of American and European capitalists formed to build large works in Switzerland for the construction of railway machinery. The annual capacity of the works will be 600 locomotives, 1000 steam railway passenger cars, 1000 electric railway cars, and 10,000 switches and signals operated by electric power. The directors are G. Burnham, of the Baldwin Locomotive Works, Philadelphia, president; J. G. Brill, of Brill & Co., Philadelphia, vice-president; W. Siemens, of Siemens & Halske, Berlin, secretary; M. de Neuflize, director of the Paris, Lyons & Mediterranean Railway, treasurer; Corneille Barbey, general man-

ager of the Yverdun & Ste. Croix Railway, managing director. It is the intention of the directors to equip the works with American machinery. Mr. Sinclair has been directed to advertise for a chief engineer for a one year's engagement at $20,000; five assistants, who will be engaged for one year, at $6000 salary; eight locomotive workshop foremen, four carriage shop foremen, and four signal shop foremen for permanent engagements, with salaries ranging from $2000 to $5000 a year. The traveling expenses from America to Switzerland and back will be paid by the company.

IS COPPER COMING DOWN?—In a report to the government, Mr. Marshal Halstead, U. S. Consul at Birmingham, cites opinion and data as to a possible break in copper prices. One effect of the copper boom has been to attract more attention to copper mining in various parts of the world outside the United States. As a result, we find in the British colonies an enormous number of copper mines now being reopened and much virgin soil developed. Mining men in Australia hope, as a matter of course, that 19-cent copper will continue for a long time to come; but, in the meantime, realizing that it will not, they are producing all they can, in order that they may obtain as much solid advantage as possible. While they realize the certainty of a fall in quotations, they have come to recognize that even on a 15-cent basis there is a satisfactory return on the metal, provided only that they adopt proper machinery and improve their methods generally. If, they argue, Americans can secure fabulous dividends over a lengthy series of years out of ground that yields from 1 to 3 per cent. of metal, surely they can do as well out of ground that averages from 10 up to 30 per cent. It is as a consequence of this somewhat tardy conviction that there has now begun the revival of copper mining in South Australia, New South Wales, Tasmania and Queensland.

AUTOMOBILES AND GOOD ROADS.—As might be expected, the introduction of automobiles has not only stimulated electrical and mechanical industries, but is now having its effect on civil engineering. The question of good roads is being taken up all over the country in regard to the improvement of the roads for the use of automobiles, and the general wastefulness of present methods is attracting attention. "Every year about $30,000,000 is spent in this country in the repairing of mud roads," says the Chicago *Tribune*. "The money is expended to no purpose, but the farmers keep on paying it out, while refusing to contribute a larger sum, which, if judiciously expended, would give them permanent roads, which it would cost but a trifle to keep in perfect condition. Then they would not have to keep as many horses as they do now. There would be less wear and tear of harness, horses and wagons. The farmers would be able to get their products to market at all times, while it happens now often that they cannot market those products when prices are highest because of impassable roads. The taxes which bear hardest on the farmers are those they unthinkingly impose upon themselves."

WESTINGHOUSE, CHURCH, KERR & COMPANY are now at work installing an entire new power plant for the Rapid Railway at New Baltimore, O. There will be ten engines, three of which will be main engines, four boilers and all the necessary machinery which will cost something over $300,000. Mr. Wallace Franklin, Detroit manager of the Westinghouse Company, has closed a contract with the Toledo, Fremont & Norwalk Electric Railway Company, to do the engineering and architectural work, supply the machinery, build the power houses, shops and overhead constructing, which foots up nearly half a million dollars. The line will run from Toledo through Woodville, Fremont, Clyde, Belleview, Monroeville to Norwalk, O., a distance of sixty miles, with the central power plant at Fremont, and seven substations. The three-phase system of distribution is to be used at 15,000 volts with direct current transformation for the road.

MANUFACTURING IN ENGLAND.—At the last annual meeting of the Electric Construction Company, when a 6 per cent. dividend was declared and satisfactory business shown, Sir D. Cooper, chairman, said: "The electric equipment of the city of South London Railway Extension, on which they were now engaged, will demonstrate that they were at least as well qualified as their American rivals to provide such installations. The directors must, however, confess that they had given cause for disappointment to a few of the company's customers by some unavoidable delay in executing orders, caused partly by novelty in the designs and partly by pressure of work. To obviate the latter, the board were making a considerable addition to the workshops and providing larger tools and appliances to cope more advantageously with the large machines now coming generally into use."

POWER CONTRACTS AT ALBANY, N. Y.—The Albany Railway has entered into a contract with the Hudson River Power Transmission Company of Mechanicville to furnish several thousand electric horse power for the operation of its lines of railway in Albany, Watervliet, Cohoes, Green Island, and Troy. A building is being erected in Watervliet by the company to be completed in December for the distribution of the power. The plan is to send the power at high voltage from Mechanicville to Watervliet, a distance of nineteen miles. The distribution house, it is believed, will also be used by the Troy City Railway, which has also contracted with the Mechanicville Company. It is understood that the General Electric Company will do the electrical work. Its factories at Schenectady already take large quantities of the Mechanicville power.

AMERICAN MINERAL PRODUCTION.—The official report on the mineral production of the United States for the calendar year 1898, shows that since 1880 the total value of the mineral production of the United States has increased from $369,319,000 to $697,880,002 in 1898, nearly 90 per cent. From 1894 to 1895 the increase was nearly $100,000,000, and in the following year the increase was only a little over $1,000,000, while from 1892 to 1894 there was a decrease, owing to the business depression, of over $121,000,000. From 1896 to 1897 the increase was about $8,000,000, while from 1897 to 1898 the increase was $66,970,534. The 1898 total product was the largest in history. The value of all metallic products in 1898 was $344,096,130, as compared with $302,198,502 in 1897, a gain of $41,897,628.

POWER CONTRACT IN BUFFALO.—The World's Dispensary Medical Association of Buffalo are making important changes in their power and machinery equipment. A large Hoe press of special construction is being installed and the power for the whole establishment is being changed to electrical transmission. The American Engine Company, of Bound Brook, N. J., furnish the engine, generator and motors. The generating plant consists of an American-Ball duplex compound engine and direct connected generator, and the motors comprise both belted and direct connected types. The lighting of the premises is also done from the same circuits.

CENTRAL AMERICAN COMMERCIAL COMPANY.—A charter has been issued under the laws of West Virginia to the Central American Commercial Company, of Cincinnati, O., for the purpose of doing a general commercial business, to secure concessions in Central and South America, to build and operate electric light and power plants, telegraph lines, etc. Capital subscribed $150,000, paid in $15,000; and they have the privilege of increasing the same to $5,000,000. The shares are $100 each and are held by Chas. W. Beck, John W. Wolfe, W. F. Rodney and E. L. Maynard, of Cincinnati, and John H. Pennington, of Chicago.

TELEPHONE CONTRACTS.—Two large contracts have been awarded by the Home Telephone Company, of Rochester, N. Y., an "independent" company. The Stromberg-Carlson Telephone Manufacturing Company of Chicago will furnish the switchboard, telephones and central office apparatus, and the cables will be supplied and put in place by the Standard Underground Cable Company of Pittsburg. The company has had elaborate plans made for its exchange building, and will proceed with its work without delay.

ALUMINUM PRODUCTION.—Last year 5,200,000 pounds of aluminum, valued at $1,716,000, were produced in the United States. The value per pound was therefore thirty-three cents. In 1888 19,000 pounds of that metal were produced valued at nearly $3.33 a pound. It is to be borne in mind that this new industry is essentially, and to all intents and purposes distinctly electrical, and is based upon the development of cheap current in large quantities.

WESTINGHOUSE MACHINE COMPANY.—The stockholders of the Westinghouse Machine Company of Pittsburg have been notified of their right to subscribe to an amount of new stock equal to their present holdings, payment in cash at par, $50 a share. The privilege to subscribe expires Sept. 20. In March the company voted to increase their capital stock from $1,500,000 to $3,000,000. The company is enjoying a business beyond precedent.

RAILS FOR HONOLULU.—A representative of the Honolulu Traction Company was in Johnstown, Pa., recently, securing bids for fifty miles of steel rails to build a trolley line in the Hawaiian capital. The Loraine Steel Company, of Johnstown, was the successful bidder. The steel is to be shipped this winter, so that the road can be completed by the end of next year.

GOVERNMENT LIGHTING.—The contract for furnishing an electric light plant for the Warm Springs Indian agency, Oregon, has been awarded to Franklin R. Anson, of Salem, Ore., at $2948. The plant is to be in running order by Oct. 1. The other bidders were H. B. Loveridge, of Portland, $4950, and Edward Heaton, of New York, $4385.

CONTRACT FOR PORTSMOUTH NAVY YARD.—The lowest bidder for the electric light building at the Portsmouth (N. H.) Navy Yard is Mead, Mason & Co. of Boston, at $29,870, the bid being made with the condition that the steel market would not permit this offer to stand beyond the 6th inst.

Special Correspondence.

NEW YORK NOTES.

New York, Sept. 4, 1899.

SIEMENS & HALSKE ELECTRIC CO. have removed their New York headquarters to 319-320 Havemeyer Building, where they will be glad to receive calls, inquiries and orders.

WARD ELECTRIC SUPPLY AND CONSTRUCTION CO.—Schedules in the assignment of the Ward Electric Supply and Construction Company of 133 William Street, filed, show liabilities of $3646, nominal assets of $1281, and actual assets of $246.

BASKET PARTY TRANSFERS.—Basket parties on the trolley cars of the Metropolitan Railway Company will no longer be possible, owing to an order issued by the company which forbids conductors issuing a transfer on top of a transfer. Heretofore it has been possible to ride all day on a five-cent fare by carefully following a route over which transfers could be secured from one line to another. In this way basket parties, popular among the poor, were enabled to enjoy a day's outing at comparatively little expense.

CURRENT FOR BROOKLYN ELEVATED.—A contract has been entered into between the Kings County Electric & Power Company and the Brooklyn Rapid Transit Company by which the former concern will supply the electric power necessary in operating the elevated trains both on the Kings County and the Brooklyn Elevated roads. The big power house of the Kings County Company at the foot of Gold Street, in Brooklyn, is very near completion, and within a month's time will be ready to furnish light and motive power.

A BROOKLYN TROLLEY REPAIR SHOP.—President Clinton L. Rossiter, of the Brooklyn Rapid Transit Company, has been authorized to build a new electrical shop at Fifty-eighth Street and Second Avenue, at a probable cost of about $65,000. Work will begin at once, and Mr. Rossiter says that it will be the finest plant of its kind in the country. Electricity and compressed air will be used almost exclusively for power, and the shop will be used for building and repairing cars, cleaning them, and keeping the electrical equipment of the system in good trim.

NO INCREASE OF BRIDGE TROLLEY TOLLS.—Bridge Commissioner Shea has abandoned his efforts to compel the trolley companies to pay a toll of ten, instead of five cents, for each car crossing the Brooklyn Bridge. After Mr. Shea had forced the elevated lines to pay an increased toll he announced that he would compel the trolley companies to pay five cents more on each car. Mr. Shea has, however, been advised, he says, that it is questionable whether he could break the agreement made with the trolley companies by his predecessors in office. The existing contract has eight years yet to run.

PAUL T. KENNY, electrical engineer and contractor, has moved from the Havemeyer Building to the Bennett Building, New York, where he located several years ago as agent for the old Mather Electric Company. At that time Mr. Kenny was fortunate in capturing some of the largest contracts given out in the city, such as the New Herald Building. Recently he has equipped the Brooklyn Daily Times Building with a lot of motors, everything in that building, from the linotype machinery to the Hoe quadruple presses, being now driven by electric power.

METROPOLITAN CONDUIT SUIT.—The Metropolitan Street Railway Company has not filed an answer in the suit brought against it last June by William H. Reiger, as a taxpayer, to restrain the company from using the conduits it has laid along its lines for any other purposes than the operation of its roads in accordance with its charter. On Aug. 31 the company obtained a third extension of time in which to answer. Commissioner Kearny, of the Department of Public Buildings, Lighting and Supplies, and the City of New York, also defendants, have defaulted by not answering the plaintiff's complaint.

TUNNEL RAILWAY FOR NEW YORK.—After placing impediments of various kinds in the way of rapid transit ever since it came into power, the Van Wyck administration has come to the conclusion that not only must the tunnel be built at once, but that it can be constructed by municipal funds. Corporation Counsel Whalen has announced that the form of contract for the construction of the underground system, which has been in his hands for over a year, is all right, with two exceptions, and he has written to George L. Rives, of the Rapid Transit Commission, and Edward M. Shepard, its counsel, asking them to meet him this week and discuss the contract and specifications and the amendments he purposes making.

LABOR MEN AND THE TROLLEY.—It was reported last week that a boycott had been declared against the Brooklyn Rapid Transit system by the allied labor unions of Greater New York, and that it will never be lifted until the railroad company recognizes the Knights of Labor. The boycott, it was said, has been carried on quietly, and is generally confined to the unions themselves. District Master Workman Pines explained that while no workmen were asked to boycott the lines of the Brooklyn Rapid Transit system, their attention was called to the competing trolley lines that ran to the same termini. All workingmen's picnic parties and individuals that went to the beaches and parks in Brooklyn were asked to patronize the Smith Street, De Kalb Avenue and Franklin Avenue lines.

MAY CHARGE TWO FARES.—The complaint of the Citizens' Improvement Association of Hollis, L. I., against the Long Island Electric Railway Company has been dismissed by the State Board of Railroad Commissioners. The complaint alleged that the railroad company was violating the law, and, besides, operating to the detriment of the village of Hollis in that two 5-cent fares were charged for the ride from or to Hollis and the Brooklyn Bridge, the latter being reached by connection with the Kings County Elevated at Liberty Avenue, Brooklyn, the entire distance being less than five miles. The company produced evidence to show that under its franchises it was permitted to make the charge, which was in vogue when the Greater New York charter went into effect; hence it could not be compelled to make a change. Trolley riding is now so cheap, some people expect to travel all day for 5 cents.

JAMAICA BAY TURNPIKE FIGHT.—Patrick H. Flynn and those interested with him in the project for the construction of a bicycle and carriage road across Jamaica Bay, it was stated last week, would contest the injunction obtained by David N. Carvalho, the handwriting expert, restraining them from building the turnpike. Mr. Carvalho obtained the injunction from Justice Smith, in the Supreme Court, Brooklyn, on Friday. He is a property owner at Far Rockaway, and he complains that the proposed turnpike would shut off the tidal action from the bay's easterly end, and seriously injure all the near-by resorts fronting on the bay. The Brooklyn & Jamaica Bay Turnpike Company, which is building the road, claims that it has a government grant to construct the turnpike. A solid roadway was not to be built, it was said, but a trestle construction, with drawbridges, which would not interfere with either tides or boats.

NEW CARS FOR THIRD AVENUE.—The first consignment of new cars for the Third Avenue surface line has arrived from St. Louis. The cars are to replace the present rolling stock when the power is changed to electricity. They are 38 feet in length and slightly broader than the present cars. They will be lighted by electricity and at each seat are push buttons for stop signals. The color of the exterior is red, of a slightly darker shade than the old cars, and the upholstering of the seats is also red. The cars are combination. In the winter they will be run as closed cars and in the summer made into open cars by the removal of the large glass windows. Instead of a long seat on each side of the car the seats are cross seats, with an aisle in the centre, the seats on each side accommodating two persons. It was expected that the change in the power system would be made by Sept. 1, but delays in getting material will prevent, and every effort is now being made to have the change made before the Dewey celebration.

TUNNEL RAILWAY.—The agitation in favor of giving Tammany thirty or forty millions to spend on a tunnel railroad is being revived. Comptroller Coler has declared in favor of a municipal construction of the rapid transit tunnel approved by the Rapid Transit Commission. He said that he stood with the people, and was ready to do all he could to carry out their wishes as expressed at the polls. Weighing his words carefully, he committed the Department of Finance to municipal ownership of what he is confident will become the city's greatest asset. "When the county debt is separated from the city debt," he said, "we will be able to add $30,000,000 to our bond issuing capacity With the margin of $22,000,000 we have now and the $13,000,000 of revenues of the sinking fund, the City of New York will be able next year to issue $65,000,000 in bonds. We can increase our water resources, and at the same time build the rapid transit tunnel. The money will be available, because it will be impossible for us to spend all we can raise." Mr. Coler rather underrates the spending ability of our politicians in Tammany Hall.

NEW ENGLAND NOTES.

Boston, Sept. 2, 1899.

THE NEW ENGLAND TELEPHONE COMPANY has completed a direct copper circuit from Rutland, Vt., to North Adams, Mass. The line runs through Fair Haven and Bennington, Vt., and will be used for long distance service between Boston, New York and Montreal, Canada.

MR. FRANK S. PRICE, of the Pettingill-Andrews Company, has sailed for Europe on a short business trip, visiting London, Paris and other important centres. Mr. Price will also thus take a much required vacation, and will doubtless return strengthened for the fall business just commencing.

AUTOMOBILES IN A POLITICAL CAMPAIGN.—The most interesting incident in the Bates-Guild campaign for the Republican nomination for Lieutenant-Governor is the news that Mr. Bates' friends have hired all the automobile carriages in the city for use on caucus night, Sept. 26. The cab company will have about a dozen automobiles in use by that time.

THE ZIEGLER ELECTRIC COMPANY, of Boston, have added to their manufacturing space by taking the entire top floor of the building at the corner of Franklin and Federal Streets, in which they have been located for several years. By this step they will about double their facilities, and will be able to give much prompter deliveries of their goods for the fall season. They are at present busily engaged in filling orders for their well-known school and college apparatus, and are preparing for a busy season in Zeco arc lamps.

THE OLD TIMERS TELEGRAPHER'S ASSOCIATION holds its reunion in this city on Sept. 12, 13 and 14. Members arriving on the Boston & Maine or Fitchburg Railroad, should take a Huntington Avenue subway car near the Union Station for the Copley Square Hotel. Those arriving on the New York, New Haven & Hartford or Boston & Albany Railroad should leave the train at the Huntington Avenue station, two minutes walk from the hotel. Mr. Grant H. Yetman is the secretary of the Entertainment Committee, at 234 Devonshire Street.

ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, of Boston, are at present building a large number of special switches for the New York Edison Company, which are to be used in various stations in conjunction with their storage battery work. The switches are from the Edison Company's own designs and are all made of copper. When completed they will weigh in the neighborhood of fourteen tons. The Anderson Company are extremely busy in all their departments and are pushing the new addition to their factory, which will, when finished, give them largely increased facilities.

LIQUID AIR COMPANY'S NEW FACTORY.—The Liquid Air Power & Automobile Company, of this city, who have been doing some very "tall" advertising, state that they have purchased the five-story and basement brick factory, corner Massachusetts Avenue and Albany Street, Cambridge, Boston. The building is 50x200, giving the company ample room for the conduct of their business of manufacturing liquid air and automobiles and other machines

run by liquid air power. The building has been equipped with a 100-hp engine, two 50-hp boilers, pumps, shafting, belting, water tanks, etc. The company was organized only a short time ago, and owns the patents of George Code, Hans Knudsen and Milton Chase for the manufacture of liquid air and its use as a power and as a refrigerant. There are many sceptics as to this whole business, and the company appears so far to have devoted its energies to selling stock.

BOSTON'S INDEPENDENT TELEPHONY.—President Z. S. Holbrook, of the Massachusetts Telephone & Telegraph Co. has received estimates for constructing 40 miles of conduits in the streets of Central Boston. Contracts will be let at once and the work will be pushed. Between four and five thousand subscribers have been secured. Practically all contracts so far secured are for five years. As soon as franchises can be secured preliminary work for the establishment of exchanges in the metropolitan district will be begun. Franchise has already been granted in Waltham. It is the intention of the company to use the "central energy" system, which does away with batteries at each telephone. In Southeastern Massachusetts the company has purchased 150 miles of wire, touching the Boston district at Dedham and Mattapan. All the above goes to show that the "independent" people are putting up a bold front, in the heart of the "enemy's country."

BELL TELEPHONE.—All kinds of reports are current as to American Bell Telephone plans and deals, and the removal to New York of the corporation. The main issue, the consolidation of the Bell and Long Distance Companies of New York, correctly known as the American Telephone & Telegraph Company, is generally regarded as settled. One rumor is that the exchange is to be made on a basis of three shares of Long Distance stock for one share of Bell Telephone, with the privilege of subscribing for an additional share of Long Distance at par, the Long Distance to pay 6 per cent. Another rumor that seems more plausible is that the exchange will be on the basis of only two shares of Long Distance for one of Bell Telephone. In the latter event there would still remain in the treasury nearly $23,000,000 of Long Distance stock. At first glance this latter rumor looks rather ridiculous, inasmuch as the Long Distance stock pays only 5 per cent., while the Bell stock is paying 15 per cent. There is an opinion in some quarters that, even if the company did become a New York corporation, its local interests would remain practically unchanged. It would make New York its headquarters only as far as it might be necessary to comply with the laws of the state. This impression is confirmed by the announcement that the company is preparing to erect a new nine-story building in Milk Street, next to its present structure.

CHICAGO NOTES.

Chicago, Sept. 2, 1899.

MR. R. LESTER THAYER, the prominent electrical engineer of Peoria, Ill., is visiting Chicago this week.

Mr. W. P. SULLIVAN has been spending a fortnight at Peoria, Ill., in the interests of the Mackenzie Furnace Co., of this city.

CHICAGO TELEPHONE COMPANY has announced a reduction of 50 per cent. in night rates between this city and towns within a radius of 50 miles.

MR. GEO. P. REX, the well-known secretary of the Columbia Incandescent Lamp Company, of St. Louis, is favoring Chicago with his presence this week. They are doing a fine business.

MR. G. G. LUTHY, general manager of the Royal Electric Co., of Peoria, Ill., was in Chicago during the last week attending to some important business for his concern, which has many new orders in hand.

THE AMERICAN ELECTRIC WIRE COMPANY has been formed in this city, with a capital stock of $5000, by C. B. Stafford, S. Wilson and I. M. Crane, to make electrical devices, apparatus and supplies.

GOOD RAILWAY EARNINGS.—Our local street and elevated railway properties are doing very well, and are all showing handsome gains. Metropolitan Elevated travel in August increased a little over 23 per cent. over the same month last year.

MR. W. B. WOODS, general sales manager of the Cornell Machine Company, is leaving for an extended business trip throughout the East. He will stop at the principal cities with a view of establishing branch offices for their gasoline engine electrical plants.

THE GREEN ENGINEERING COMPANY, of Chicago, have just closed an order with the West Chicago Street Railway Company for 20 Green traveling link grates, and another with the United Railways Company, of St. Louis, for 16 of the same grates. These are said to be the largest orders of this kind ever placed.

BADT-GOLTZ ENGINEERING COMPANY.—Mr. Edward A. Meysenberg has resigned as an officer of Meysenberg & Badt, and has retired from the active management of the concern. The company has, therefore, changed its name to the Badt-Goltz Engineering Company, which indicates the work they are doing, and the "personalties" behind it. The style describes the two active members of the firm.

MILWAUKEE, WIS.—For the second time within a month the police have been called upon by the Milwaukee Electric Railway & Light Company to assist in the discovery of men who have stolen the copper wire from suburban lines. The latest theft reported was one of 1000 feet of wire from what is known as the Pabst Avenue line, which connects Milwaukee with the suburb of Wauwatosa. It is said that besides the dismantling of the country club line nearly a mile of wire was taken from the poles on the Waukesha Beach line from about the first of August. The company offered a reward of $100 for the capture of the thieves. Three men, who are said to have stolen a large quantity of wire from electric railway lines in Illinois, are now in jail, but it is thought that there are several gangs at work in the neighborhood of the city.

THE CHICAGO EDISON COMPANY has just closed a contract for the electrical equipment of the new office building now in process of construction for the Fayette Land & Construction Company, at the corner of Fayette and St. Paul streets, Baltimore, Md. The contract comprises two 14x14 engines, direct connected to two 75-kw dynamos, switchboard and instruments, wiring in iron armored conduit for 3400 incandescent lights; also wiring in conduit for a duplicate system of telephones throughout the building; also watchman's clock system, and system of call bells, speaking tubes, etc. George A. Fuller Company are the general contractors for the building, and the building is to be completed and the plant in operation early next spring.

STREET RAILWAY PLANS.—It is said that the Chicago Union Traction Company, which operates the West and North Chicago Railways, will not try to secure an extension of their franchises until they expire, July 30, 1903, four years hence. Had the traction companies decided to operate under the Humphrey bill, they would have had to pay 3 per cent. of their gross receipts each year from the first Tuesday in September, 1897, to the city. But not doing so, they can save $1,600,000, and can take up the franchise question at the proper time. Should the contract be made with local parties for the use of the water power on the drainage canal, it is believed that the traction company will use this current, as it might be more economical than running separate power plants.

MR. E. W. HAMMER, the president and general manager of the Chicago Rheostat Company, has been in the East during the past two months in the interests of his company, and has established a branch factory in New York City for the manufacture of his products. This was made necessary by the rapidly growing Eastern and export business of the company. The Chicago Rheostat Company has enjoyed a phenomenal growth during the past year under the management of Mr. Hammer, notwithstanding the active competition in the rheostat business. He will devote most of his future personal efforts to the building up of the Eastern factory, and may, later on, remove to New York with his family. The New York address of the Chicago Rheostat Company is 39 Cortlandt Street. The Chicago end of the company will be in charge of efficient hands, and local customers will always be well taken care of, as in the past. It is generally understood that Mr. Hammer has established some enviable relations in the East and that congratulations are in order.

ILLINOIS ELECTRIC COMPANY.—A year and a half ago, the Illinois Electric Company, of Chicago, made its first effort in the electrical supply business. Starting, however, with an experience gained by many years of service with an ample reserve of push, they have demonstrated their "business getting qualities." That their methods have the approval of the purchasing public is evident by the constantly growing list of customers, and by the increasing amount of sales. They are now about to distribute a telephone catalogue, a handsome volume bound in dark blue with gold lettering, and containing over 100 pages all devoted to the telephone interests. This catalogue has been carefully compiled, and it is believed contains everything pertaining to telephones, telephone construction and maintenance; it is systematically arranged by departments, carefully indexed, and it must certainly be of value to all purchasers of telephones and material used in connection therewith. Quite a compliment is paid the telephone interests by a recognition of their importance in the publication of this special volume, and there is no doubt that this will be greatly appreciated by them. Preparations are now being made for a general catalogue, embracing everything used in the electric light, power and domestic installation. This will be a volume of about 500 pages, and will be up-to-date in every particular. Everything that is standard or special, and used in the diversified electrical interests, will find a place in it. It is the intention to have this ready for distribution about Nov. 1.

PHILADELPHIA NOTES.

Philadelphia, Sept. 4, 1899.

MR. C. L. BUNDY, of the Philadelphia Electrical & Manufacturing Company, has been confined to his home for several weeks by sickness. He has now gone to the White Mountains for a complete change and rest, and his many friends are cheered by hopes of his early and speedy recovery of wonted health and vigor.

SOUTH BETHLEHEM, PA.—The South Bethlehem & Saucon Street Railway Company has been incorporated with a capital stock of $30,000, to construct a road between South Bethlehem and Saucon, Northampton County. Andrew Cope, president, and C. P. Hoffman, South Bethlehem; W. H. Miller, Emaus, Pa., are incorporators.

PRINCETON, N. J.—M. Taylor Pyne has completed negotiations for the purchase of three farms between Princeton and Lawrenceville, and through this purchase has frustrated the plans of the Trenton Trolley Company. The farms are located below Mr. Pyne's residence, between the Trenton Turnpike and the Stockton road. The trolley company, which could not get the right of way to Princeton through the Stockton road, had mapped out plans to get into the college town by the turnpike. Being now shut off from this route, it will have to extend the road at least a mile eastward at Cox's Corner if it wants to come to Princeton.

ENTERPRISE AT NARBERTH.—The Narberth Heat & Light Company, of Narberth, has been chartered. The plant will be in operation in the near future. It is not only to do lighting, but hot water heating. The system to be adopted is that of hot water conveyed to the houses through underground pipes. It has been demonstrated by long and actual tests that hot water can be sent a distance of more than two miles and returned to the central plant with the loss of less than two degrees in heat. This fact indicates that the operations of the plant may be extended as far as Wynnewood, the adjoining town, and which has many fine villas. This borough improvement is attracting much attention, and is in line with other operations that have brought the town into prominence recently.

OHIO NOTES.

Cleveland, Sept. 2, 1899.

URICHSVILLE, O.—The Urichsville & Newcomerstown Electric Railway has secured franchises from the councils of Newcomerstown, Port Washington and Gnadenhutten and will commence work of construction at once.

THE CLEVELAND TELEPHONE COMPANY, of Cleveland, has been having considerable annoyance of late with thieves who make a pretense of using the various "nickel-in-the-slot" pay stations scattered throughout the city, instead of which they open the coin box with blank keys and then beat a hasty retreat.

FOSTORIA, O.—The city council of Fostoria has refused to grant a franchise through the city to the Findlay, Fostoria & Toledo Electric Railway, and the promoters of the road have decided to leave Fostoria to one side, passing through Arcadia, ten miles to the west of the city, and then due north to Toledo. The new route shortens the road considerably.

THE CLEVELAND MACHINE SCREW COMPANY, this city, is building a large addition to its plant on Second Avenue, which will be utilized in the manufacture of the Sperry electric carriage. It was first intended to use the company's plant on Perkins Avenue for this purpose, but this establishment has recently been purchased by the bicycle combination just formed.

THE MIAMI VALLEY BELT RAILROAD, operating southwest from Toledo, is erecting an extensive power house at Miami. It is being built between the Erie Canal and the Maumee River, and by a mill race from the canal to the river, the water of the former will be utilized for power. The power house will also be equipped with steam power to be used during certain periods of the year.

TOLEDO TO NORWALK.—The Toledo, Fremont & Norwalk Electric Railway Company has secured the necessary franchises between Toledo and Norwalk, and the bids for the construction of the portion of the road between Toledo and Fremont will be closed in a day or two. This portion of the road will be built at once. The Norwalk end will be constructed next spring. The company already has under advisement the construction of branches from Norwalk to Mansfield, thirty miles south, and to Oberlin, twenty miles east. The latter line, connecting with the Cleveland, Elyria & Oberlin Railway, will give a continuous line from Cleveland to Toledo.

CLEVELAND STRIKE SITUATION.—The boycott against the Cleveland Electric Railway Company, Cleveland, continues with few indications of a break. President Everett claims that more people are riding on the cars every day, and says that as soon as stormy weather sets in the public will again patronize the cars fully. He also claims that a number of the strikers are back at work. The strike leaders claim that only a very few men have gone back to work and that the public is more in earnest than ever in its boycott. The strikers claim that they are making good money with the busses which they are operating. Nearly fifty herdics were brought from Washington and other cities last week to be used in paralleling the lines of the Big Consolidated where busses are not already in operation. The strikers claim to have ample financial backing and it is reported that the leaders are investigating the advisability of forming a permanent company to operate automobile busses.

THE COPE BRAKE ORDINANCE for street cars which was passed in Cleveland some time ago, is causing many controversies in the street railway and legal circles of this city. The ordinance provides that electric cars operated in Cleveland must be provided with the latest improved brakes other than the chain brakes in common use. The ordinance fixed a fine of $25 per day for every car not equipped in the manner described. The railway officials claim that the chain brake is the best and safest, and point to the fact that accidents have occurred with cars equipped with electric brakes because of the liability to short circuit, also because that kind is rendered absolutely ineffective when the trolley leaves the wire. Mayor Farley holds that the ordinance is a good one and says it will be strictly enforced after Sept. 1, when it goes into effect. On the other hand, Law Director Beacom, of the mayor's cabinet, says that if the claims of the railway officials are true they cannot be compelled to change their brakes. The railway companies have made no effort to obey the ordinance and a legal fight is looked for.

ST. LOUIS NOTES.

St. Louis, Mo., Sept. 2, 1899.

KINMUNDY'S, ILL., LIGHT PLANT.—The work of stringing the wires for the electric light plant was completed Aug. 28, and the plant will be in operation Sept. 12.

NEW POWER HOUSE.—The United Railways Company will soon build a new power house on Park and Vandeventer Avenues to cost $1,000,000 equipped. It will be one of the largest in the world.

THE ST. LOUIS OFFICE of the General Incandescent Arc Light Company has been moved from the Security Building to 638 Century Building. It will hereafter be known as a sales office of the "G-I" Company, instead of a branch of the Martin J. Insull Company, as heretofore.

WESTERN ELECTRICAL SUPPLY COMPANY.—Several orders for Adams-Bagnell arc lamps, amounting in all to 500, have been sent in this week by the representatives of the Western Electrical Supply Company, who are agents in this territory for that specialty. They also report business as exceedingly good in all other lines.

FROM CABLE TO ELECTRICITY.—The St. Louis Railway company has applied to Supervisor of City Lighting for permission to erect 608 poles on Broadway in order that the line may be changed to electricity before winter. It is said that the track is in such bad repair that it will not last through the winter, although it was intended not to begin the work of reconstructing the line uptil spring.

STATIONARY ENGINES.—The eighteenth annual convention of the National Association of Stationary Engineers will meet in St. Louis this week. The local committee of arrangements is composed of Frank Eardley, chairman; John Hauge, vice-chairman; H. H. Wheeler, treasurer; A. B. Hazzard, secretary, and Thomas S. Bevins, William Manson, William Schermund, Joseph E. Bell and William L. Skinner.

HANDSOME GIFTS.—Mr. McCulloch, on returning home the day after the banquet that is mentioned below, found awaiting him a fine piece of Dresden china. Mr. Duffy found awaiting him a handsome open-faced watch with his initials, the date and "From the National Railway Boys" engraved on the back. They were both delicate ways of expressing regard. The gifts were doubly appreciated on account of the way they were presented.

MR. MINARY REMEMBERED.—The employees of the Southern Electric Railway met Tuesday night and bid farewell to Mr. Jos. S. Minary, late general manager of that road, who has been transferred to the superintendency of one of the northern divisions of the United Railways Company. He was presented with a handsome chain and locket, the latter containing the picture of himself and wife. Mr. Minary presented the relief association of the road with $160 which he raised among the directors of the company and others. Mr. Minary was also presented by the employees of the Southern Electric Express Company with a fine umbrella.

GAVE THE "BOSSES" A BANQUET.—The employees of the Broadway, Baden, Southwestern, Citizens', Northern Central and Union lines gave an entertainment at Bellevue Garden, Aug. 28, to their former employers, Messrs. Robert McCulloch and C. Nesbitt Duffy. It was a testimonial banquet in the form of a surprise, and the guests consisted of about 500 employees of the road together with a number of street railroad magnates of St. Louis. The men and officials were intermingled at tables arranged parallel down the garden with the two guests of honor, President Corwin H. Spencer, of the National Railway Company; R. D. Ellis, W. J. Orthwein, Christian Peper and F. C. Whittemore at a smaller table at the end. It was a cold water affair in deference to Col. McCulloch and Mr. Duffy, neither of whom "indulges." At the termination of the banquet two handsome volumes, bound in morocco, and containing the names of all the employees of the road, were presented to Mr. McCulloch and Mr. Duffy. After responses by the recipients, speeches were made by both employees and officials in praise of the departing officials and the relation between capital and labor in metropolitan railway affairs.

INDIANA NOTES.

Indianapolis, Sept. 2, 1899.

TELEPHONE EXCHANGE NEARING COMPLETION.—The telephone line for which the city of Bloomfield granted a franchise to T. C. Murray is nearing completion. He says the new exchange will be opened in about a week. The Murray company is erecting a complete telephone plant, and within a short time will have connection by toll lines with all the smaller towns in that section.

A NEW TRACTION LINE ORGANIZED.—The Northern Traction Company, composed of Pittsburg, Pa., and South Bend capitalists, has been organized by electing ex-State Senator Morgan H. Weir president. The company has already begun work on an electric railway connecting Laporte and Michigan City. The money for the construction of the road was secured in New York.

A TELEPHONE FRANCHISE GRANTED.—The town council of Linton has granted a franchise to the O'Farrell Telephone Company for twenty years. The company agrees to erect a plant at once. The company claims to have franchise rights in Worthington and Bloomfield, and proposes to connect them with Linton. The claim of having rights in Bloomfield is denied by the authorities of that town.

LOCAL COMPANY'S PATRONS REMAIN LOYAL.—When fire destroyed the exchange of the Mutual Telephone Company at Shelbyville, a few weeks go, the fear was that the stockholders would become discouraged and dispose of the plant. The plant had only been completed a few weeks and the Indianapolis line in operation only a week when fire destroyed everything in the exchange. A move was made three hours after the fire to rebuild the exchange, and it has been successful. Overtures have been made for the purchase of the plant for the purpose of turning it over to the Central Union, but these have failed. The rebuilt exchange will be in operation in a few days.

TAXATION.—The fifty days' session of the Indiana Tax Board is almost at an end. The Western Union Telegraph Company asked for a rehearing and stated by its representative that the board had assessed its property at more than its true value, and that the assessment was unequal, not uniform and unjust. The board had placed an assessment of $375 a mile on the 6474 miles of lines the company operates in the state, which was an increase of $50 a mile over the assessment last year. It was contended that the lines had been assessed at more than it would cost to construct them again. Expert testimony was introduced to the effect that the cost of constructing a line consisting of one wire would not exceed $65 a mile, and the cost of each additional wire $17 per mile. Statistics were introduced showing that Indiana made up almost all of one district of the company. In Indiana the pole mileage is 6474 and in the district 6795. The wire mileage in the state is 29,455 and in the district 36,819. The gross receipts of the company in the district for the year were $386,196 and the expenses $322,997. The average profit on each message in the district was two and three-tenths cents and in the entire system five and four-tenths cents. The average line in the state did not consist of more than four wires, which could be constructed, including the right of way, at a figure between $109 and $126 per mile. The life of a telegraph wire was said to be about thirty years and the life of a pole about fifteen years. Notwithstanding these contentions on the part of the Western Union, the board gave no evidence of an inclination to reduce the assessment. This case is a sample of many others.

MEXICAN NOTES.

Austin, Tex,, Sept. 1, 1899.

MR. A. L. ROSSEN, formerly of Waco, Texas, is manager of the Topo Chica street car system in Monterey, Mexico. This system was recently purchased by Mr. S. W. Slayden, a capitalist of Waco.

COLIMA, MEXICO.—The Governor of the State of Colima, Mexico, has signed a contract with a company formed for the purpose of establishing an electric light and power plant in the city of Colima.

THE MEXICAN NATIONAL PALACE.—Several hundred incandescent electric lights have just been put in in the National Palace in the City of Mexico, Mexico. The building is now thoroughly lighted.

ENGINEER AUGUSTINE CHAVEZ, the director of the Federal telegraph system of Mexico, has recovered from a severe and protracted illness. He is about to begin an inspection of the telegraph lines of that country.

THE MEXICAN GOVERNMENT has let the contract for the laying of a cable between the ports of Altata, in the State of Sinaloa, and La Paz, in Lower California. The distance is 114 miles. The work must be completed within six months.

CHAPULTEPEC.—A large number of new electric lights are being installed in the Castle of Chapultepec and the surrounding grounds. This beautiful spot is the summer home of President Porfirio Diaz. It is located just outside the old walls of the City of Mexico.

LIGHTING CATHEDRAL TOWERS.—The towers of the magnificent cathedral in the City of Mexico are being literally plastered with colored incandescent electric light globes. It is a tedious job, as the workmen have difficulty in holding on to the steep sides of the walls of the tower. There will be over ten thousand globes on the towers when the work is completed, which will not be before Sept. 10. The lights will be turned on on the night of Sept. 15 for the first time, in honor of President Diaz's birthday anniversary, The effect of the illumination will be novel.

THE MONTEREY MINERAL RAILWAY, a narrow gauge line, 24 miles long, running from Monterey, Mexico, to the San Pedro mining district, was sold recently by Colonel Joseph A. Robertson, its builder and owner, to a syndicate of American capitalists consisting of Charles J. Peabody, George D. Cook and Arthur B. Turner, of Chicago; George F. Peabody, Acosta Nichols, Robert S. Towne, William F. Gillespie, Charles J. Nourse, Jr., and Edward M. Shepard, of New York City. It is announced on the authority of one of the members of the board of directors of the new company that it is proposed to convert the road into an electric freight and passenger line. The road connects with all the manufacturing concerns and the other railways entering Monterey and does a large traffic in hauling ore from the mines in the San Pedro district to the smelters at Monterey.

General News.

THE TELEGRAPH AND TELEPHONE.

BELLE PLAINE, IA.—The Belle Plaine Telephone Company has filed articles of incorporation.

THE TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., will, it is stated, erect a new factory.

OTTUMWA, IOWA.—The Iowa Telephone Company is about to make a large expenditure for new cable, switchboards and instruments. It is said that about $10,000 will be spent in this improvement.

WAVERLY, TENN.—The Humphrey County Telephone Company has been formed Capital, $1000. Incorporators: C. M. Stribling, F. P. Gould, R. A. Jackson, W. H. McCauley, J. A. Box, all of Waverly.

LOUISVILLE, KY.—Mr. C. A. Ray, of the Louisville Fire & Police Telegraph Company, has just closed a contract for his company to furnish the city of New Orleans with a fire alarm telegraph plant, the cost to be $73,340.

COVINGTON, IND.—The Covington & Coal Creek Telephone Company has been formed to operate telephone lines and exchanges. Capital, $10,000. Incorporators: A. P. Burnsides, E. C. Snoddes, A. Shaw, C. Marlatt, J. Rhoads, all of Covington.

GALENA, KAN., is one of the latest additions to the independent telephone field. The Sterling Electric Company, of Chicago, received the contract for exchange apparatus, including switchboard, distributing board and protectors complete.

WILMINGTON, DEL.—The Clinton Telephone Co., Wilmington, for telephone, telegraph and messenger service, has been incorporated. Capital, $50,000. Incorporators: G. W. Kimball, Charles W. Smith, James L. O'Neill, all of Wilmington.

BURLINGTON, IA.—The Mutual Telephone Company of Burlington has filed articles of incorporation. It has a capital stock of $2500. The business of the company is managed by a board of directors consisting of Robert Moir, Jr., Robert Hodson, Walter Stutts, R. T. Robinson, James Moir and Alex. Moir.

AKRON, OHIO.—Theodore Wakeman has been appointed assignee of the Akron District Telegraph Company. The American District Telegraph Company placed call boxes throughout the city, giving free services, forcing the local company out of the business. The liabilities exceed the assets by $2000.

ROCHESTER, N. Y.—The Home Telephone Company has purchased property here for the purpose of providing a building for its central office and exchange. The directors of the Home Telephone Company express a determination to give the city of Rochester a telephone plant which shall be at least equal to any other in the United States.

LEWISTON, ME.—At its annual meeting the Lewiston & Greene Telephone Company elected the following named officers: Clerk, Eli Hodgkins; treasurer, E. L. Mower; directors, J. H. Gilman, E. A. Dudley, Dr. H. M. Blake, Leon Pettingill, G. T. Howe, F. A. Morse, Ernest Saunders; J. H. Gilman, president; Dr. Randlette, general manager. The company now has about 30 miles of line with 22 instruments and several more subscribed for.

MANCHESTER, N. H.—The Manchester Telephone Company, one of the leading independent telephone companies in New England, is now in the hands of temporary receivers, George H. Warren of that city and Albert W. Worthly of Boston having been appointed to take charge of the company's affairs. Mr. Warren stated that the company would continue, and that it was expected that a sale would be made within a few days.

ALBANY, N. Y.—The Granville Telephone Company has been incorporated. The capitalization is $10,000, and the general route and points to be connected are from Granville, Washington County, taking in the towns and villages in Washington, Warren and Essex counties, and the counties of Rutland and Bennington, Vt. The directors are Franklin T. Pember, Henry Dillingham, William H. Hughes, Emmet Wyman, Willis A. Tenney and Fred W. Hewitt, of Granville; Fred W. Allen, Anthony T. Hughes, of Middle Granville, and Frank E. Hicks, of Slyborough.

AMERICAN BELL TELEPHONE.—The American Bell Telephone Company reports for the month ended Aug. 20 its instrument balance sheet as follows:

	1899.	1898.	Changes.
Gross output	42,140	24,863	Inc. 17,277
Returned	15,389	12,022	Inc. 3,367
Net output	26,751	12,841	Inc. 13,910
From December 21 to Aug. 20:			
Gross output	432,039	212,747	Inc. 219,292
Returned	125,154	95,328	Inc. 29,826
Net output	306,885	117,419	Inc. 189,466
Total outstanding:			
August 20	1,432,135	1,036,540	Inc. 395,595

LYONS, N. Y.—The Syracuse, Rochester & Lake Ontario Telephone Company has been organized here, to operate a telephone system between Syracuse and Rochester, Oswego and Rochester, covering the intermediate territory and paralleling the Bell Telephone Company's lines. The capital stock is $100,000. The directors are E. Sherman Bishop, Rhinebeck, N. Y.; Ledyard S. Cuyler, Clyde W. Knapp, Dr. Charles H. Towlerton, William S. Scott, Jacob Straus, of Lyons; Alvin B. Bishop, Sherman E. Bishop, Archibald M. Graham, of Clyde. The incorporators are stockholders and directors of the Wayne County Telegraph & Telephone Company, at present operating exclusively in this county.

MORE ALLEGED COMBINATION.—A despatch of Aug. 30 from Chicago says: Reports were current in financial circles to-day of a combination of all the independent telephone enterprises in the country. It was said that the organization papers for the amalgamation were being prepared. At the office of the Strowger Automatic Telephone Exchange, President A. G. Wheeler said: "A combination in the nature of a co-operative arrangement is natural and necessary. As the independent movement grows and expands, the co-operation will develop, and in four or five years at the most all companies opposed to the Bell system will have what might be called a traffic agreement and will work in unison."

ELECTRIC LIGHT AND POWER.

LARIMORE, N. D., will build a $1000 electric light system.

HASTINGS, NEB., will build and operate an electric lighting plant.

AUSTIN, MINN., will soon have a city electric light station at a cost of $12,000.

MANAWA, WIS.—The Little Wolf River & Lumber Company will purchase and install a plant of 75 or 100 lights capacity.

SHREVE, O.—The Shreve Electric Light & Power Company has been formed with $8000 capital. Incorporators: E. K. Gardner, H. J. Good.

TUXEDO, N. Y.—The Tuxedo Electric Light Company has been formed by Richmond Talbot and Chas. S. Patterson, Tuxedo Park. Capital, $80,000.

PETERBOROUGH, N. H.—The town of Peterborough, N. H., obtained permission of the last legislature to establish a village electric lighting plant.

PARIS, FRANCE.—A special despatch of Aug. 31 reports the damage by fire of the electric light plant at La Chapelle, Paris, to the extent of $200,000.

LIGHTING RAT PORTAGE.—A new company at Rat Portage, Ont., promoted by Mr. D. C. Cameron, has made a proposition to that town for street lighting.

PORTERVILLE, CAL.—The Porterville Light & Power Company has been formed, with a capital of $10,000, by W. H. Hammond, A. G. Wilson, A. D. Wilson.

COMMERCE, TEX.—The Commerce Electric Light Company has been formed. Capital, $10,000. Incorporators: T. U. Thompson, L. W. Rutland, J. D. Jernigan.

MIDDLETOWN, N. Y.— The Catskill Mountain Electric Company has been formed. Capital, $100,000. Incorporators: J. M. Brush, Fleischmanns, N. Y.; G. H. Lashen.

KAMLOOPS' POWER PLANT.—A petition will be presented to the City Council of Kamloops, B. C., asking that a by-law be prepared to raise funds for improvements to the city power plant.

FREEPORT, L. I.—The work of enlarging Freeport's electric light plant will begin soon. New boilers, another engine and incandescent dynamo will be added to the machinery already at the power house.

RICHWOOD, O.—The Richwood Light, Heat & Power Company has been formed. Capital, $5000. Incorporators: E. A. Schambs, G. M. Schambs, R. Smith, M. C. Wolgamot, J. F. Millen, all of Richwood.

LAKEWOOD, N. J.—The Lakewood Water, Light & Power Company has

been incorporated with a capital of $150,000. Incorporators: Frederick H. Green, Wm. H. Blair, Carroll Ph. Bassett, Summit, N. J.

ORANGETOWN, N. Y.—The Rockland Light & Power Company, of Orangetown, Rockland County, has been formed. Capital, $75,000. Directors: William C. Bradley, George L. Chapman and Robert P. Barry.

TUNKHANNOCK, PA.—The Tunkhannock Electric Company has been formed with a capital of $15,000, with $1500 paid in. Incorporators: S. W. Eysenbach, treasurer, Tunkhannock; T. B. Russell, Wilkes-Barre, Pa.

YOUNGSTOWN, O.—The Colonial Electric Company has been formed for dealing in electrical supplies, etc. Capital, $100,000. Incorporators: T. H. Gillmer, B. W. Gillmer, E. E. Roberts, E. E. Nash, W. C. Wood, all of Youngstown.

CALUMET, MICH.—The Calumet & Hecla Mining Company is installing a complete new system of electric lighting for the mine location streets. Sixty arc lights are being put up and the expense is being borne entirely by the company.

DEADWOOD, S. D.—The Black Hills Electric Light Co., of Deadwood, are to install a new steam and electrical plant and have placed an order with the Royal Electric Co., of Peoria, Ill., for a 125-kw alternator operating at 2200 volts.

CLEVELAND, O.—The Electric Controller & Supply Company has been formed for the manufacture and sale of electrical supplies. Capital, $30,000. Incorporators: C. H. Wellman, J. McGeorge, H. McGeorge, C. H. Gall, T. H. Bushnell, all of Cleveland.

BAKER CITY, ORE.—The Eastern Oregon Power Company has been formed with a capital of $100,000, to erect and operate electric power plants for mining, milling and other purposes and electric railways. Incorporators: F. Baillie, A. Geyser, J. T. English.

SYCAMORE, ILL.—Mr. W. V. Henrie, one of the shareholders of the Sycamore Electric Light & Power Company, has petitioned the Circuit Court for the appointment of a receiver. Since the city put in a plant and lighted her streets, the company has failed to make its plant pay.

MECHANICVILLE, N. Y.—The Halfmoon Light, Heat & Power Company has been incorporated to carry on operations in the village of Mechanicville. The capital stock is $20,000. The directors are: H. O. Bailey, Fred H. Ferris, E. H. Strong, John C. Duncan and George B. Tripp, all of Mechanicville.

KENOSHA, WIS.—An electric service plant will be put in the early part of next year by the present operators of the Kenosha Light & Power Company. The managers will spend a little over $30,000 on the new addition. Work has been begun on the new heating plant which will be put in by the same company. It is expected that the heating system will be in operation by the 1st of October.

DUBUQUE, IA.—The Home Electric Company has filed articles of incorporation. The capital stock is $100,000 and the company is to continue for twenty years. The new company owns the franchise lately owned by the Dubuque Light & Traction Company, and its incorporators are F. D. Stout, W. J. Brown, John Ellwanger, D. D. Myers, Geo. W. Kiesel, B. W. Lacy and Hindsill Parsons, who also constitute the board of directors. The following are the officers: President, D. D. Myers; vice-president, John Ellwanger; secretary and treasurer, Geo. W. Kiesel; general manager, W. J. Brown.

THE ELECTRIC RAILWAY.

PORT HURON, MICH.—Albert Dixon has been elected president of the City Electric railway, to succeed William Canham, retired.

ST. LOUIS, MO.—The St. Louis, Clayton & St. Charles Railway Company has been incorporated, with $50,000 capital stock, by J. H. Blessing and F. A. Huter, of St. Louis.

WESTCHESTER COUNTY, N. Y.—A certificate of extension of the route of the New York, Westchester & Connecticut Traction Company has been filed with the Secretary of State.

COLUMBIA, S. C.—The Columbia Street Electric Railway has been purchased for $257,500 by W. B. Smith Whaley and associates, of Columbia. Extensions and improvements will be made.

AUGUSTA, GA.—The Augusta Railway & Electric Company has, it is announced, perfected plans for a 15-acre park at Summerville, involving the construction of a double track through the park.

ANNAPOLIS, MD.—The Annapolis City Council has decided to refuse a franchise for a railroad through the streets of that city. This defeats the project to connect Annapolis and Washington by trolley.

ALBANY, N. Y.—The stockholders of the Albany, Helderberg & Schoharie Electric Railway Company have voted to change the name of the corporation to the Albany & Schoharie Valley Railroad Company.

MACON, GA.—Application was made on Sept. 1 for a charter of the North & South Macon Street Railway Company to construct a street railway three miles long in Macon. Senator A. O. Bacon and others are interested.

JACKSON, MICH.—The Jackson, Albion, Marshall & Battle Creek Street Railway Company has been granted a franchise in Blackman township to build an electric railway. W. A. Foote, Jackson, is one of the promoters.

COPAKE, N. Y.—A trolley company is being organized to construct a passenger and freight electric railway between Copake, N. Y., and the Boston & Albany, at West Springfield, 67 miles. Water power will be used to generate the current.

LANSING, MICH.—The North Detroit Electric Railway Company has been incorporated to construct and operate a street railway. Capital, $50,000. Incorporators: J. Winter, D. W. Simons, F. C. Andrews, O. H. Lane, J. W. Smith, J. H. Andrews.

HUNTINGTON, L. I.—E. D. Davidson, Huntington; S. R. Williams, Amityville, N. Y., and others are interested in the construction of an electric railway from the Long Island Railroad at Huntington to Great South Bay, about eleven miles.

READING, PA.—The Reading & Millmont Street Railway Company has been incorporated with $12,000 capital stock, to construct an electric street railway. Wm. H. Luden, president; M. N. Ritter and Jas. W. Yocum, all of Reading, are incorporators.

ATLANTA, GA.—The directors of the Atlanta Railway & Power Company have declared an increase of 20 per cent. in the wages of conductors and motormen both in the employ of the Atlanta Railway & Power Company and the Atlanta Railway Company.

DOVER, DEL.—The New York Financial Trust Company has been formed to buy and sell railroads, telegraph and telephone lines. Capital, $100,000. Incorporators: O. G. Wales, W. F. Berkowitz, E. F. Haynes, of New York City; Jas. Virdin, of Dover, Del.

HAMILTON, O.—The Hamilton & Lebanon Electric road has been incorporated with a nominal capital by Frank Hughes, E. A. Belden, J. E. Hughes, S. D. Fitton, Jr., and Clarence Clawson. The villages of Monroe and Bethany are on the proposed route.

LA CROSSE, WIS.—The town of Melrose, Jackson County, this state, has voted $10,000 bonds to aid the construction of the La Crosse, Black River Falls & Neillsville electric railroad, to be built at once from this city to Neillsville, making the longest electric freight and passenger railroad in the West.

CEDAR RAPIDS, IA.—Vice-President Williams, of the Burlington, Cedar Rapids & Northern, has announced that the road will extend its line from Worthington to Hardwick, Minn., at once. It is believed here that the road will go to Woonsocket, S. D., next year, and possibly into the great wheat region.

ROSELLE, N. J.—The Borough Council has passed an ordinance granting a franchise to the Elizabeth & Westfield Street Railroad Company to complete the last link in the line from Plainfield to Elizabeth. The franchise is granted for ninety-nine years, beginning Jan. 1, 1900. The road must be in operation by April 1 next.

PEKIN, CHINA.—The first electric railway in China, which was projected and constructed at Pekin by the Siemens & Halske Electric Company of America, is to be extended into the city by breaking a gate through the walls. The road was opened June 24 last, running from the Pekin station at Machiapu to the south city gate.

FLUSHING, L. I.—The New York & North Shore Railroad, which is building an extension of its line from Flushing to Jamaica, succeeded last week in executing a coup against the Long Island Railroad. The trolley company laid its rails over a strip of land which the Long Island had taken measures to prevent it from entering.

UTICA, N. Y.—Work has been commenced by the Utica Belt Line Railroad Company to extend its tracks from the present terminus at New York Mills to New Hartford. When this line is completed passengers can ride through New York Mills, Capron, New Hartford and back to the starting point, without changing.

COLUMBUS, O.—The Columbus Railroad Company has been incorporated with a capital stock of $7,000,000, divided equally in common and preferred. The company is organized to purchase the Columbus Central road, recently ordered to be sold on a decree of foreclosure and to consolidate that property with the Columbus Street Railroad.

PENSACOLA, FLA.—The Electric Street Car Company is receiving bids for the construction of a new electric light and power house under a franchise granted at last session of the legislature. The company is allowed the privilege of conducting a general electric lighting and power business. It will also extend the present electric car system.

DANVERS, MASS.—The movement for building a new electric road between Danvers and Georgetown, through Topsfield and Boxford, is again taking shape, and already 1055 shares have been subscribed for. There is a capitalization of $120,000. The road is to be known as the Danvers & Georgetown road, and the line to be built is twelve miles.

KANKAKEE, ILL.—F. L. Bridgeman has secured an option on property near here for the purpose of supplying power for Chicago traction lines. Mr. Bridgeman says a syndicate composed of Eastern capitalists and Joseph Leiter, of Chicago, will build a dam across the Kankakee River to secure water power for the electric plant. The syndicate has invested $20,000 in the project.

PHOENIX, ARIZ.—The Third District Court of Arizona has ordered foreclosure of the bonds of the Phoenix Street electric railway, issued at 6 per cent., in 1893, to the amount of $250,000. The debts now aggregate $356,427. The main creditor is the receiver of the People's Home Savings Bank, of San Francisco. The main stockholder and president of the company is M. H. Sherman, formerly of Phoenix.

DETROIT, MICH.—A new electric railway between Detroit and Toledo is projected. A thirty-year franchise has been granted to Joseph Waltz, of Waltz; John W. Simcock, of New Boston; George Stellwagon, of Wayne, and Frank L. Edwards, of Carleton. The line is to be equipped with a modern overhead trolley system and is permitted to carry passengers, mail, express and all kinds of freight. The proposed route is between Detroit and Toledo via Monroe, Waltz, New Boston, Romulus and thence to Detroit.

SALEM, O.—The Alliance, Seybring & Salem Electric Railway Company has been granted a 25-year franchise by the commissioners of Columbiana and Mahoning Counties. It is stipulated that the fare from Alliance to Salem shall not exceed 25 cents. The original incorporators of the company are H. W. Klein, of Allegheny; J. C. Whitla and H. C. Estep, of Salem; W. H. Morgan, Charles Baker, W. H. Harris and Daniel Fording, of Alliance. The road is to run from Alliance to Salem, a distance of 14 miles, through the towns of Seybring, Beloit, Damascus and Garfield. Work will be begun shortly on a power house large enough to furnish power and electric light to all the towns.

LEBANON SPRINGS, N. Y.—The Lebanon Springs road has been bought under judgment by Mr. John Delehanty, of New York, who will, it is said, turn it into an electric road, taking in the chief points in Columbia County.

FREEMANSBURG, PA.—The Freemansburg town council has granted the franchise for an electric street railway to the South Bethlehem-Freemansburg Street Railway Company. The new ordinance was the sixth one framed, and carries a 5-cent fare, and a $200 tax per year, which the trolley company agreed to. The road will be built from South Bethlehem through Iron Hill to Freemansburg, to Butztown to Bethlehem.

PONTIAC, MICH.—Tracks of the Sylvan Lake Street Railway Company, on Saginaw Street, the main thoroughfare of the city, were torn up recently by a gang of men from Detroit. The latter are understood to have been employed by aldermen and other citizens. The cause for indignation against the company is the fact that the railway company opposes paving of the street, and has enjoined the city from proceeding therewith.

TAUNTON, MASS.—A meeting will be held in this city in a few days to form another electric street railway company. The proposition is to run a line from the Taunton Street Railway to Easton, a total distance of seven and a half miles, and connecting there with the Brockton line for Boston. It is believed this will make the shortest route between this section and Boston. Many Taunton people are interested in the proposed line.

JOPLIN, MO.—The Southwest Missouri Electric Railway is to be still further extended. Several prominent New York capitalists are said to be interested with the present company in the project. At present the electric line connects Carthage, Joplin, Webb City, Carterville and other Missouri towns with Galena, Kan. The plan of the new company is to extend the line to Central City, Neck City, Duenweg and Oronogo, Mo., to Empire, Weir City and Baxter Springs, Kan. The new road is to be standard gauge, and will haul freight as well as passengers.

BUFFALO, N. Y.—The Buffalo & Lockport Railway Company will make an extension to its lines in Lockport. The Lockport Common Council has granted a franchise to the International Traction Company to extend the street railway system to complete a belt line about the northern portion of the city and to provide an outlet to the proposed Olcott extension. Work must be begun within 30 days and be finished by Jan. 1, 1900. An effort to incorporate a provision for a three-cent fare for an hour morning and night failed. The new line will tap the mill district.

TRENTON, N. J.—The Pennsylvania Railroad has filed a map with the secretary of state, laying out a route through the lower part of this city for a proposed trolley road, and has been at work several days securing written consents of property owners to lay tracks. The company has also made an agreement with the Trenton Street Railway Company, which holds a monopoly of the local franchise, permitting it to build and operate the proposed new road. It is understood that Pennsylvania proposes to construct and operate a trolley road which will have a continuous connection between Jersey City and Washington, and that the movement here is the first step in the carrying out of this comprehensive plan.

AURORA, ILL.—The Aurora, Yorkville & Morris railway is the name of a new road organized last month in Aurora. It is proposed to build the line from Aurora down the Fox River valley as far as Montgomery before October, and, if nothing interferes, the road will be completed on to Oswego before winter sets in. The officers are: President and treasurer, Senator Evans; vice-president, U. P. Hord; secretary, Senator Case; directors, the above named officers and F. D. Winslow. The contracts for the building of the road as far as Montgomery have been let to the Aurora Street Railway Company. Senator Evans has already leased a farm near by and will fit it up as a park. The capital stock has been placed at $150,000.

SALT LAKE, UTAH.—Articles of incorporation of the Valley Railroad Company have been filed. The capital is $200,000, in 2000 shares. The incorporators and officers are: James Campbell, president; Edmund Wilkes, vice-president; Henry C. Rollins, secretary and treasurer; Campbell, Wilkes, Rollins and William C. Hall, all of Salt Lake, and Archer S. Cook, of San Francisco, directors. The object is to build an electric road from the suburbs of Salt Lake to the town of Bingham, the oldest mining town in Utah, a distance of 14 miles. The entire issue has been subscribed and $1000 per mile paid in. Passenger rolling stock has already been purchased and contracts for freight cars will be closed at once. For passenger service the trolley or third rail system will be used.

THE AUTOMOBILE.

AKRON, O.—The Frantz Body company will engage in the manufacture of automobile bodies. A large addition to the present plant will be erected.

UNITED STATES MOTOR VEHICLE COMPANY has been formed under the laws of New Jersey with a capital of $1,500,000, by C. J. Field, W. P. Reid and F. H. Field.

INDIANAPOLIS, IND.—The H. T. Hearsey Vehicle Company has been formed to buy and sell automobiles, carriages, etc. Capital, $20,000. Incorporators: H. T. Hearsey, T. M. Staley, F. I. Willis, all of Indianapolis.

CHIEF CROKER, of the New York Fire Department, is testing a steam propelled fire engine, with gasoline flame under a vertical boiler. It weighs 400 pounds, and can speed up to 40 miles an hour. It carries enough gasoline fuel for 100 miles.

AUTOMOBILE CLIMBS MOUNT WASHINGTON.—Mr. and Mrs. F. O. Stanley, of Newton, Mass., accomplished the ascent of Mount Washington, N. H., in an automobile on Aug. 31. This is the first time Mount Washington has been climbed by such a machine. The ascent was accomplished in two hours and ten minutes. The descent was also safely made.

MRS. L. H. DAVIS, who reached Chicago recently in a gasoline automobile, after an exciting and vicissitudinous trip, says: "So far I have met but one woman who is using a gasoline carriage with success and she lives in Conneaut, Ohio. As a rule the electric trap appeals more forcibly to the feminine heart, for it is cleaner, easier to handle and requires practically no mechanical knowledge." And so say all of us.

PARIS, FRANCE.—The American Automobile & Motor Company, Limited, has just concluded a contract with the Locomobile Company, of America, of which Mr. A. L. Barber is president. The company has acquired all the rights of the Stanley automobile. The American Automobile & Motor Company will receive about half the production of these machines in the course of a few weeks and be able to supply all demands. They have secured large showrooms at 79 Rue Duret. The company will also handle electric vehicles. The officers of the company are: Mr. Frank L. Gerdner, chairman; Mr. Albert Geiger, of Boston, vice-chairman; Mr. Sebastian B. Schlesinger, MM. R. de la Ville, Le Roul and P. Soberano and Baron de Villaine, directors. Vicomte de Jotemps is the general manager, with offices at 47 Boulevard Haussmann.

THE AUTOMOBILE CLUB OF AMERICA has now been duly incorporated at Albany. George F. Chamberlain is the acting president and Homer W. Hedge the secretary. The club expects to have 300 applications for membership by Oct. 1. The membership list is limited to 400. Mr. Hedge states that a club house will be built where non-resident members can be entertained. A stable for the housing of the automobiles will be secured. As already noted, the most important work of the club will be the part it purposes taking in legislation for good roads. This will be national in its character. It will seek to protect the interests of automobile owners everywhere. The club has already been recognized by similar organizations that have been chartered in Great Britain, France, Germany, Austria, Switzerland and Belgium. The initation fee for the first 100 members is $25, and $50 for the others. The annual dues will be $25.

NEW COMPANIES.

IMPERIAL ENGINE COMPANY, of Painted Post, N. Y., has been formed with a capital of $20,000. Directors: Charles M. Morse, J. R. Rand, Jr., and F. W. Parsons.

LISBON, PORTUGAL.—The Companhia Carris de Ferro Lisbon has been organized in London, England, with a capital stock of $5,000,000, to acquire all the tramways of that city and to operate them electrically.

THE WESTERN CARBON COMPANY, manufacturing and dealing in electrical supplies and appliances, has been formed. Capital, $30,000. Incorporators: J. F. Sanders, C. C. H. Fyffe, R. B. Mason, all of Chicago.

DULUTH, MINN.—The Northwestern Power & Transportation Company has been formed. Capital, $500,000, with $10,000 paid in. Incorporators: Murphy & Blatz, 103 Front Street; Francis A. Cokefair, Crescent Avenue, both of Plainfield, N. J.

AUSTRALIA.—The Australian General Electric Company of Schenectady has been organized with a capital of $50,000. Directors: Edgar A. Carolan, Edward Clark, James O. Carr, Henry W. Darling, Harold Footman, Elmer E. Gilbert and Myron F. Westover.

EDUCATIONAL.

INSTRUCTION IN PHYSICS, 1899-1900, is the subject of a pamphlet just issued by the Johns Hopkins University, Baltimore. The pamphlet gives a description of the apparatus in the laboratory, together with an outline of the subjects covered in the regular course of instruction. The laboratory is well fitted with apparatus and instruments designed for experiments and investigations in applied electricity. Mr. J. B. Whithead will give lectures on the application of physics to such questions as electric transmission of power, alternating current apparatus, etc.

LEGAL.

A PHONOGRAPH SUIT.—Frederick M. Prescott, formerly head of the Edison Phonograph Agency, 44 Broad Street, New York City, has brought suit in Chancery in New Jersey against Thomas A. Edison, the National Phonograph Company, William E. Gilmore, Charles E. Stevens and others, for a "conspiracy to destroy" his business. Mr. Edison, when asked about this suit, said: "We have asked for an injunction to restrain Mr. Prescott from using my name. Because we brought this suit, he has instituted the proceedings in the Chancery Court. It is only a bluff suit." A large amount of foreign business was done through the agency abroad.

OBITUARY.

MR. ARTHUR DREW.—We regret to announce the death of Mr. Arthur Drew, who has been for so many years the secretary and treasurer of the Electric Gas Lighting Company of Boston. Lately Mr. Drew has not been in very good health, and by his physician's order sailed from New York on Aug. 5 for the benefit to be derived from the voyage. On the voyage, however, he grew worse, and it was thought better that he should return at once, and accordingly he sailed on the Catalonia Aug. 15. He grew rapidly worse, and on the day after sailing he passed away, and was buried at sea Aug. 18. Apoplexy was given as the cause of death, undoubtedly caused by overwork. Mr. Drew was widely known in Boston, and had also a large number of friends in the electrical business throughout the country. Mr. Drew leaves a widow to mourn his loss.

PERSONAL.

MR. NEWTON HARRISON has been appointed an instructor and lecturer, for electrical subjects, at the Newark, N. J., Technical School.

MR. ALEX. DOW, general manager, etc., of the Detroit Edison Company, is a visitor in the East, accompanied by Mrs. Dow, and will stay until after the Edison convention in Philadelphia next week.

MR. LOUIS J. STEELE, chief electrician of Verity's, Limited, has been in this country on an engineering trip, and also spent several weeks in British Columbia, visiting territory hitherto unexplored. Mr. Steele left for England last week, and before doing so made very satisfactory arrangements for the manufacture of three or four of his inventions in this country.

MR. R. Mc. A. LLOYD, of the Electric Boat Company, while controlling some bolting horses not long ago had the misfortune to injure one of his fingers, which has since been amputated. We are glad to record the welcome news that this is the limit of the injury, and that Mr. Lloyd has quite recovered from the accident, being confirmed, however, in his views as to the superior docility of the automobile.

MR. G. WILBUR HUBLEY, who it will be remembered, gave an interesting paper at the last meeting of the National Electric Light Association, has been appointed sole agent at Louisville, Ky., for the American Electric Vehicle Company. Kentucky has hitherto been a chosen home of the thoroughbred, but this is the day of the automobile, and the Blue Grass State proposes to be "placed" in the race, under the new conditions.

MR. W. J. LATTA.—It is announced that General Agent William J. Latta, of the Pennsylvania Railroad, one of the most widely known officials of that corporation, has presented his resignation and will retire from the employ of the company on Sept. 15. It is said that Mr. Latta is to become president of a company which is to be formed for the purpose of doing a general electric lighting business, and which is to amalgamate the interests of the Pennsylvania Manufacturing Company and the National Electric Company. Mr. Latta has been with the Pennsylvania since 1869.

GEN. IRVING HALE, who has just returned from Manila to his home in Denver, expresses the firmest of convictions that the Filipinos are now and long will be incapable of self-government, but nevertheless he speaks of them with kindly appreciation as a people of many good qualities and presenting material on which the influences of civilization may hopefully be exerted. Before leaving for the Philippines, Gen. Hale represented the General Electric Company in Colorado, etc.

MR. G. MARCONI is about leaving for these shores to report the international yacht races by his wireless telegraph. He remarked to a friend recently: "Do you think that it will create much surprise if I succeed in sending a message from America to England? People were much astonished when I spoke of transmitting messages without cable across the English Channel, a distance of thirty or forty miles, yet the thing is now an established fact. A transatlantic message would have to travel a very long distance, and I do not say that I am prepared yet to perform the feat. Still, many things which seemed impossible have been accomplished."

Trade and Industrial Notes.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, have just issued a neat pamphlet illustrating and describing their Utility cardboard and celluloid shades.

PETITE LAMP.—The Western Electric Company has recently placed upon the market the Marine type of their Petite lamp suitable for shipyards and lake vessels.

THE IRONCLAD RESISTANCE COMPANY, Westfield, N. J., have just issued a very neat and interesting catalogue of their theatre dimmers. It is replete with cuts and descriptive matter showing all the latest improvements.

THE WESTERN ELECTRIC COMPANY are agents for hot wire ammeters and voltmeters made by the Stanley Manufacturing Company. These instruments are either direct or alternating current and are of two types, viz., for switchboard work or portable use. They are accurate, dead beat, possess a wide range of adjustment and are invaluable for general central station use.

THE SCRANTON SCHOOLS.—A feature of the National Export Exposition at Philadelphia will be an exhibit by the International Correspondence Schools, Scranton, Pa., illustrating their method of teaching by mail. The bound volumes of their instruction and question papers as well as work done by students, including numerous drawing plates, may be inspected by visitors and a representative will be in charge to give full particulars.

FIELD RHEOSTATS.—Catalogue No. 996 of the Ward Leonard Electric Company, Bronxville, N. Y., has for its subject enamel field rheostats of the Carpenter type. More than 150 rheostats are listed, and the several types under which these come are illustrated in well-executed engravings. Accompanying the catalogue are sheets illustrating and listing continuous duty rheostats, motor starting rheostats with automatic release, regulating rheostats, motor speed regulators, "overload" and "no voltage" rheostats and ventilating fan regulators.

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, have recently gotten out two pamphlets illustrating some electrical novelties which are thoroughly practical and seem to fill a long felt want. One illustrates their "Ever Ready" dry battery lamp. These are made in the form of interior searchlights, electric gas lighters, dental lamps, night lamp and candle. The other illustrates small storage battery lamps, whose battery can be recharged from any incandescent circuit. They are adapted for use as bicycle, photographers, carriage and watchman's lanterns. These lamps would seem especially serviceable anywhere where it would be dangerous to carry an exposed light. They mail these pamphlets on application.

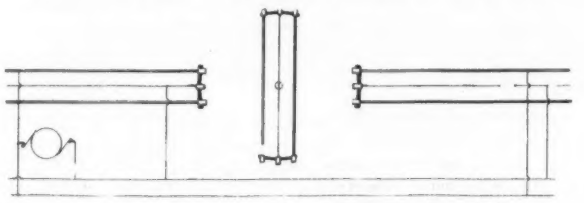
LIGHTNING PROTECTION.—The complete destruction of the central office of the Mutual Telephone Company, at Shelbyville, Ind., through heavy currents getting past the arresters and office terminals, is said to be the latest evidence of the fallacy of attempting to protect exchanges with quarter ampere fuse arresters. As a result of their severe experience, the Shelbyville company have replaced their plant with a complete equipment from the Sterling Electric Company, Chicago, including switchboard, cross connecting and distributing board, and entire protective system of combined office terminals and protectors, pole top terminals and line fuses. The Sterling Company delivered and installed all this apparatus in about three weeks, which was itself a remarkably quick piece of work just at this time.

NORTH ELECTRIC COMPANY.—Probably no single device has made its want felt in the independent telephone field more than the repeating coil. A great many companies have been compelled to use some sort of a repeating device, and the North Electric Company, of Cleveland, O., now come to the front with what they claim to be quite a step in advance in this class of equipment. They are putting out what is called a "transformer type" of repeating coil. It is a double spool affair with an absolutely closed magnetic circuit. It has eight sections wound into four different spools and the whole bound together by the very best soft Swedish iron core. The North Electric Company claims that this coil is absolutely perfect in the matter of balance and that it shows a gain of at least 20 per cent. in efficiency. They report that they are having special success with this device and that the demand is steadily increasing. Exchanges which are making connections between metallic and grounded lines might well afford to test the claims made for this new type of repeating coil.

THE BLOWER SYSTEM of ventilation and heating is applied on a large scale in the passenger car paint shop of the Pittsburg, Columbus, Cincinnati & St. Louis Railway Company, Columbus, O. The construction of a car paint shop is materially different from that of the ordinary one-story structure. This difference is most evident in the character of the roof, which is covered with a series of monitors, each corresponding to a line of track beneath. This arrangement, together with the presence of cars within the building, practically prevents the supply of air by forcing it horizontally from overhead outlets. The apparatus is located in one corner of the building, and the air is distributed through an overhead system of galvanized iron piping, extending entirely around the inside of the building at some distance from the walls. Between each pair of tracks pipes are brought down, so as to deliver the air very near the floor, where it naturally spreads, and whence it gradually rises in a well-distributed mass. One of the important advantages of the introduction of this system of heating in a building used for this purpuse lies in the increased rapidity with which the cars may be dried, owing to the large volume of fresh air constantly coming in contact with the paint. In other words, with this system the same number of cars can be dried in a given time in a smaller building than by the usual methods—certainly an important element in deciding upon the system to be adopted. The system is that of the B. F. Sturtevant Company, of Boston, Mass.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 22, 1899.



631,491.—Preventing Drawbridge Accidents.

631,491. PREVENTING ACCIDENTS ON DRAWBRIDGES TO ELECTRIC CARS; S. E. Phillips, Washington, D. C. App. filed May 2, 1899. Opening the drawbridge cuts off the current from the power circuit, while closing the bridge restores the circuit; hence, the cars are prevented from running into an open draw.

UNITED STATES PATENTS, ISSUED AUG. 29, 1899.

631,769. ELECTRIC HAMMER; J. Anderson, St. Louis, Mo. (App. filed Sept. 19, 1898. This apparatus consists of a standard, the upper portion of which comprises a hollow core electromagnet, in which an armature reciprocates vertically, said armature forming a hammer, the lower end of which is brought into contact with the metal laid upon the anvil below. A suitable switchboard, for controlling the electrical energy through the magnet, is arranged adjacent to the hammer.

631,786. SPACE BLOCK FOR LAMINATED ARMATURES; H. Geisenhoner, Schenectady, N. Y. App. filed Dec. 15, 1898. The space blocks commonly used for ventilating the armature are in this case made by a projection from one of the iron laminations of the core, instead of by means of a separate brass block or lug.

631,796. STORAGE BATTERY; H. H. Knepper, Chicago, Ill. App. filed June 27, 1898. (See Current News and Notes.)

631,809. PRESSURE GAGE; A. L. Nicla, J. H. Optenberg and E. H. Son-

nermann, of Sheboygan, Wis. App. filed May 20, 1899. Electric contacts are arranged at predetermined limits of the movements of the needle and a quick acting contact device is controlled by the needle to close the circuit when the needle reaches either limit, and send in an alarm.

631,810. SEPARATOR FOR ACCUMULATOR PLATES; H. Osborn, Chicago, Ill. App. filed Oct. 6, 1898. The separator is made of wood and provided on one side with a series of channels extending across the face, and on the other side with a similar series extending at right angles to the first series, thereby producing openings at the intersection of the channels for the circulation of the solution.

631,816. ELECTRIC ARC LAMP; G. C. Pyle, Indianapolis, Ind. App. filed Dec. 24, 1898. This lamp is intended for locomotive headlights, the invention consisting of the details of construction for obtaining certainty of action.

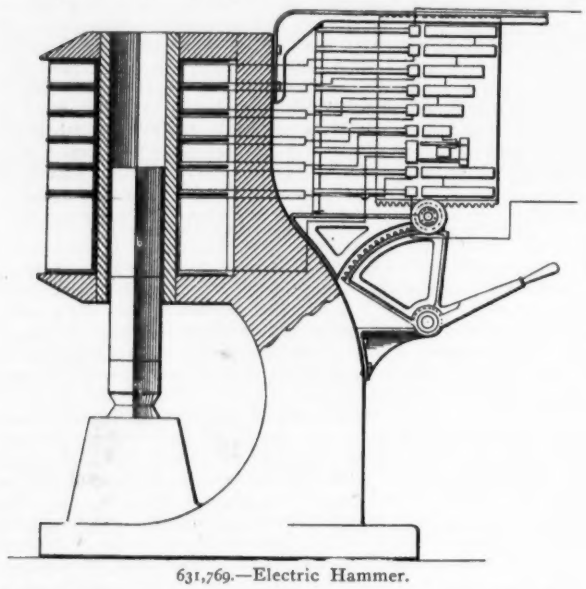
631,854. TROLLEY POLE RETRIEVER; D. E. Lesser, Warren, Pa. App. filed June 15, 1898. An arrangement of a weight in a tube, such weight carrying a pulley over which the trolley cord passes. The weight is provided with a latch which normally holds the weight inactive, but which is disengaged by the upward movement of the trolley pole.

631,864. COUPLING FOR ELECTRIC OR OTHER WIRES; R. Thompson, Passaic, N. J. App. filed June 23, 1899. The ends of the wires are hooked and engage with a half sleeve which surrounds the joint in such a way as to leave the underside of the wire flush.

631,869. SIGNAL MECHANISM; G. B. Gray, Crafton, Pa. App. filed May 6, 1899. The signal is locked at the circuit position by an electrically controlled device and the circuit includes two independent circuit breakers operated by a train, and necessitating the operation of both of them simultaneously in order to release the signal.

631,871. ELECTRICAL MEASURING INSTRUMENT; C. M. Jewell, Chicago, Ill. App. filed Feb. 4, 1899. To make an instrument which will stand rough usage, the rotatable armature is mounted in bearings which are fixed securely to the pole pieces of the magnet, a soft iron core being also secured between the pole pieces by non-magnetic brackets, the whole being arranged so that it may be removed as a unit, for the purpose of adjustment.

631,888. ELECTRIC GAS LIGHTING DEVICE; W. E. Cram, Boston, Mass. App. filed Jan. 7, 1898. In connection with a switch which makes and



631,769.—Electric Hammer.

maintains contact between the electrodes of the igniting circuit, a thermostatic device is used, adapted to break the igniting circuit at the burner under the influence of the gas flame while contact is still maintained at the switch.

631,892. ELECTRIC PUSH BUTTON; L. Johnson, Easton, Pa. App. filed May 29, 1899. The movable button has a flange with a straight bevel on its inner side, and the case has a corresponding bevel to form a close joint when the two bevels come together, for the purpose of preventing plugging of the button.

631,919. ELECTRIC MOTOR; Riccardo Arno, Turin, Italy. App. filed March 5, 1898. (See Current News and Notes.)

631,959. ELECTRIC HEATER; E. S. Gold, N. Y. App. filed Jan 8, 1898. The resistant coils are supported in the frame of the heater by means of small rods, which pass through them and touch the convolutions at one point only.

631,965. ELECTRIC ARC LAMP; W. S. Okun, New York. App. filed Oct. 23, 1895. One portion of the invention relates to the carbon feeding mechanism, another to means for permitting the carbon to have independent lateral movement where it passes through the arc enclosing globe, and another portion refers to means for making the globe air-tight. The last consists of a globe closed air-tight below the arc and having a cover provided with an opening for the carbon and above said cover a supplemental cover, also provided with an opening for the carbon. The supplemental cover furnishes double security against entrance of air.

631,970. ELECTRIC TERMINAL; F. Schwedtmann, St. Louis, Mo. App. filed Feb. 27, 1899. The terminal is formed from drawn metal tubing and has a portion flattened to adapt it for contact, and another portion cylindrical for the end of the wire.

631,975. MEANS FOR OPERATING ELECTRIC ARC LAMPS; Herbert A. Wagner and Denney W. Roper, St. Louis, Mo. App. filed May 25, 1899. (See Current News and Notes.)

632,019. CONTROLLING SYSTEM FOR ELECTRIC MOTORS; F. A. Merrick, Johnstown, Pa. App. filed March 27, 1899. This system is applicable where it is desired to control a train comprising a number of motor cars, from one or more points on one of such cars. The apparatus embodies a plurality of separately actuated contacts for varying the motor speed, separate electromagnets responsive to different current conditions for controlling the respective contacts, and a circuit including a plurality of such contacts and a manually operated master controller comprising controlling means for changing the current conditions of such circuit.

632,033. TROLLEY; C. L. Weyand, New York. App. filed April 29, 1899. This is an electromagnetic device for automatically locking the pole to prevent its swinging on its pivot, the moment it leaves the wire.

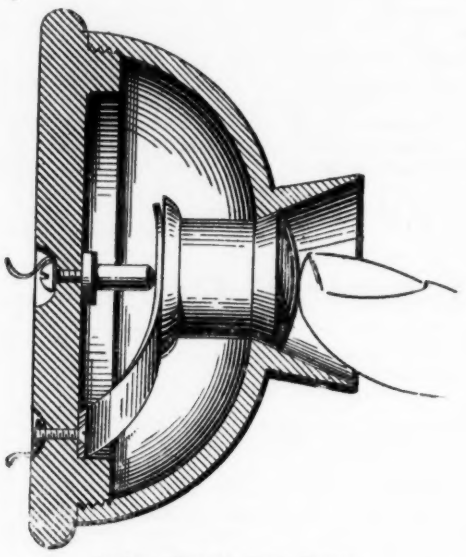
632,039. AUTOMATIC CONTROLLING SYSTEM FOR ELECTROMOTIVE DEVICES; John Balch Blood, Newburyport, and Frank A. Merrick, Newton, Mass. App. filed July 11, 1898. (See Current News and Notes.)

632,046. TELEGRAPH REGISTER; E. B. Ellicott and B. Oehring, Chicago, Ill. App. filed Sept. 16, 1898. The escapement and releasing mechanism therefor are so arranged that a very slight expenditure of power will release it, the invention relating to the details of construction.

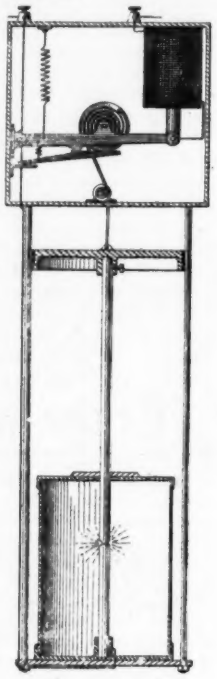
632,052. SWITCH FOR TROLLEY WIRES; A. K. Humphrey, Allegheny, Pa. App. filed Nov. 10, 1898. This switch consists of the usual plate with a special arrangement of tracks and switch tongues.

632,058. INCANDESCENT ELECTRIC LIGHT BULB; R. Mossgrove, Jr., Studentville, O. App. filed Nov. 26, 1898. This invention is a skeleton mold for blowing longitudinal corrugations in lamp bulbs without impairing the transparency of the glass.

632,066. TELEPHONE EXCHANGE SYSTEM; Charles E. Scribner, Chicago, Ill. App. filed Dec. 18, 1888. (See descriptive article.)



631,892.—Electric Push Button.



631,965.—Electric Arc Lamp.

632,067. MULTIPLE SWITCHBOARD SYSTEM; Charles E. Scribner, Chicago, Ill. App. filed Nov. 14, 1891. Renewed Nov. 16, 1896. (See descriptive article.)

632,076. ELECTRIC SWITCH; A. E. Wells, Pittsfield, Mass. App. filed Feb. 7, 1898. Details of construction intended to reduce sparking and afford simplicity in construction.

632,106. VISUAL SIGNAL APPARATUS; R. Einbigler, New York. App. filed March 29, 1899. This invention is a general improvement in hotel annunciator apparatus.

632,144. ELECTRIC METER; A. Pelloux, Geneva, Switzerland. App. filed Dec. 16, 1898. The meter comprises stationary field coils arranged in the measuring circuit, and stationary shunt coils divided into individual sections; a rotary armature is energized by the shunt coils during the rotary motion, and current switching devices are operated by the movement of the armature to insert said shunt coil sections into the circuit successively.

632,145. TIME SWITCH; H. S. Prentiss, Elizabeth, N. J. App. filed Feb. 19, 1897. The time switch embodies an ordinary switch lever, a spring pressed lever adapted to engage the said levers. a latch retaining the spring pressed lever and an electromagnet having its armature in connection with the latch for releasing the switch operating lever when the magnet is energized for causing the latter to operate the switch lever.

632,211. ELECTRIC CONDUCTOR SUPPORT; J. M. Anderson, Boston, Mass. App. filed July 27, 1897. This device is for supporting trolley wires in such way as to prevent sparking when the trolley wheel meets and leaves the support, it also furnishes efficient means for securing the wire.

Does

QUALITY

AND

EFFICIENCY

count with you on high voltage work?

If so, you will specify LOCKE INSULATORS.

Send for Catalogue No. 4.

FRED. M. LOCKE, VICTOR, N. Y.

An electric lamp makes a good light, but—

The *illumination* produced is either bad or wasteful, or both, unless you use a

HOLOPHANE GLASS GLOBE

over it. Holophanes convert all kinds of light into good illumination.

Our Book, "Light vs. Illumination," is well worth your sending for. Sent free.

HOLOPHANE GLASS CO., 1 Broadway, New York.

A NEW LINE...

of exceedingly compact and handsome permanent magnet switchboard instruments, especially adapted for use on high grade telephone and other boards where space is valuable.

VOLTMETERS,
AMMETERS,
OHMMETERS.

Over All Dimensions, 7" x 7". *Send for prices.*

WHITNEY ELECTRICAL INSTRUMENT CO.
GENERAL SELLING AGENTS:
MACHADO & ROLLER, 203 BROADWAY, NEW YORK.

PROMPT SHIPMENTS OF ALTERNATING CURRENT DESK and BRACKET FANS.

EMERSON ELECTRIC MFG. CO., ST. LOUIS, MO., U. S. A.

15 HOURS for a day's work...

with the night hours the most effective of the lot, is what a merchant has a right to expect from his show windows. If, in lighting his store, you install Frink's Patent Special Show Window Reflector, you make his store stand out in contrast to others, by reason of the superb lighting of his window displays. A comparison of windows lighted by the ordinary and out-of-date methods, and those lighted by the Frink System is a clinching argument. At least give your customer a chance to have the best, by submitting an estimate. We send this to you free, upon receipt of measurements. It's to our interest to make it an estimate that will get you the contract.

I. P. FRINK, 551 Pearl St., NEW YORK.

Keystone Electrical Instrument Co.

MAKE AND CARRY IN STOCK

A FULL LINE OF SWITCHBOARD AND PORTABLE INSTRUMENTS.

including

Voltmeters, Ammeters,

for both direct and alternating currents.

POLARITY INDICATORS AND ARC LIGHT VOLTMETERS AND GROUND DETECTORS.

"COMBINATION PORTABLES"

Available for both direct and alternating current.

901 Montgomery Ave., PHILADELPHIA.

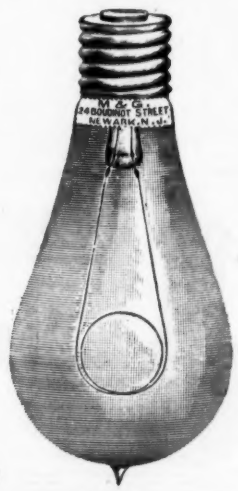
Chicago: 315 Dearborn St. New York: 15 Cortlandt St. Boston: 170 Summer St.

DON'T TRUST THE TRUST

They Promise Much, but Perform Little.

WE ARE NOT IN THE COMBINATION,

therefore are masters of our own actions, and if we can quote you prices 25 per cent. lower than the Trust is it not to your interest to patronize us? We make a lamp which for life, efficiency and economy can not be excelled. This we GUARANTEE. Write us.

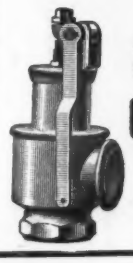


M. G.

MIDNIGHT GLOW.

McLaren & Goodchild, 24 Boudinot St., Newark, N. J.

CROSBY STEAM GAGE AND VALVE CO.



APPROVED and ADOPTED BY THE U. S. GOVERNMENT.

Crosby Pop Safety Valves

ARE A PERFECT PROTECTION FROM EXCESS OF STEAM PRESSURE.

STEAM ENGINE INDICATORS.
GAGE TESTERS.
PRESSURE GAGES.
VACUUM GAGES.
ORIGINAL SINGLE BELL CHIME WHISTLES.
FEED WATER REGULATORS.
WATER RELIEF VALVES.
BRANDEN RUBBER PUMP VALVES.
LUBRICATORS, ETC.

SPRING-SEAT GLOBE AND ANGLE VALVES.

All Working Parts Renewable.

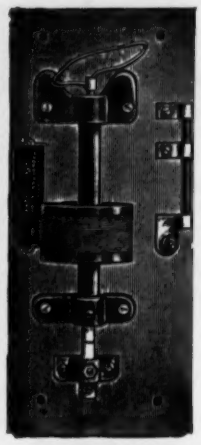
GUARANTEED NOT TO LEAK AT HIGH PRESSURES.

Made Yoke or Plain Top.

Iron or Brass Bodies.

Stores: 95 Oliver St., BOSTON. 78 John St., NEW YORK. 21-23 W. Lake St., CHICAGO. 75 Queen Victoria St., LONDON.

Office and Works, BOSTON, MASS.



STREET RAILWAY STATION ARRESTER.

THE GARTON
LIGHTNING ARRESTER
Is the Standard Everywhere.

DURABLE,
RELIABLE,
EFFICIENT.

11 Different Styles and Types.

For both Alternating and Direct Current of any voltage.

For Circulars, Prices, Etc., address your dealer or

GARTON-DANIELS ELECTRIC CO.,
KEOKUK, IOWA.

"HARDY" LAMPS give full candle power for longer time than other makes.....
HARDY LAMP COMPANY, PITTSFIELD, MASS.

LONDON. PARIS.

TROTTER'S
COMMUTATOR COMPOUND
NEW YORK

For Sale by all Supply Houses throughout the United States.

Mona Commutator Compound, the most efficient lubricator, is the only article that is guaranteed to stop sparking. It can be used on leaf carbon or gauze wire brushes with the greatest safety. Puts a beautiful lustre on the commutator. Does away with the use of sandpaper or any other material that wears out or destroys its surface. It is the largest and most economical stick manufactured. It comes in 2 sizes. Small size, $3 per doz. Large size, $5. Samples mailed free on application.

Manufactured only by TROTTER'S MONA MFG. CO., LTD., No. 65 WEST BROADWAY, N. Y. CITY.
Messrs. Goldmark & Wallace are the sole agents for the United States, 121 Worth Street, New York City.
SATISFACTION GUARANTEED OR MONEY REFUNDED.

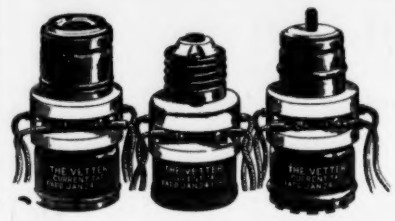
A Stylish Window Display
Is a good index to the character of a store. It is the magnet that attracts trade. Many excellent effects are lost because the illuminating medium is poor.

WHEELER REFLECTORS
are designed to meet the requirements of progressive store-keepers who desire to draw trade to their establishments through the medium of the window. We have closely followed all modern improvements in show window displays and are prepared to solve knotty questions in store lighting. Our Catalogue "Show Window Dollars" or Pamphlet No. 20 deal directly with the problem; send for them.
We have reflectors for every purpose, Electricity, Gas or Oil.

WHEELER REFLECTOR CO., Boston, Mass.

Our NEW IMPROVED BATTERY keeps the
American Electric Vehicle Co.
IN THE LEAD — PIONEERS ALWAYS
Send for Catalogue of Carriages
56 W. Van Buren St. Chicago, U. S. A.

CAN YOU AFFORD IT?



It costs only One Dollar, and surely there is over one hundred times that much convenience and comfort in

The Vetter Current Tap.

A simple device for tapping one incandescent lamp and conveying the current therefrom to operate a fan motor, a disk or a drop without affecting the lamp tapped.
Made in Parallel or Series.

Send for Circular No. 66, with prices and discounts.

E. B. MEYROWITZ, Manufacturer and Patentee
104 E. 23d Street, New York. Also at 125 W. 42d Street.
604 Nicollet Ave., Minneapolis. 360 St. Peter St., St. Paul.

ALPHABETICAL INDEX TO ADVERTISERS.—*Continued from Page 20.*

Smith Premier Typewriter Co.....30
Spencer Electrical Co.....55
Sperry, B. N.....4
Splitdorf, C. F.....3
Sprague Electric Co.....62
Standard Electric Time Co.....
Standard Paint Co.....
Standard Telephone & Electric Co.....55
Standard Thermometer and Electric Co..12
Standard Underground Cable Co.....72
Stanley & Patterson.....1
Stanley Instrument Co.....15
Sterling & Son, W. C.....10
Sterling Electric Co.....52
Sterling Varnish Co.....30
Steward Mfg. Co., D. M.....17
Stewart Electrical Co.....
Stewart & Co., Frank H.....10
Stilwell-Bierce & Smith-Vaile Co.....29
Stirling Company, The.....66
Stone City Telephone Mfg. Co.....
Storage Battery Supply Co.....28
Storey Motor & Tool Co.....2
Stow Mfg. Co.....70
Strock, S. C.....10
Stromberg-Carlson Tele. Mfg. Co.....57
Sturtevant Co., The B. F.....59
Stucky & Heck.....11

Telephone Mfg. Co.....55
Thomas & Sons Co., R.....17
Thompson, Guion.....53
Thompson, Edward P.....
Thompson, Son & Co.....50
Toerring Co., C. J.....26
Toomey, Frank.....50
Townsend & Decker.....47
Triumph Electric Co.....20

Union Boiler Tube Cleaner Co.....1
Union Hardware Co.....10
Union Porcelain Works.....13
United Correspondence Schools.....47
United Electric Improvement Co.....
United Electric Heating Co.....28
United States Carbon Co., The.....1
Utica Fire Alarm Telegraph Co.....50

Valentine-Clark Co.....10
Van Dorn & Dutton Co.....50
Varley Duplex Magnet Co.....3
Varney & McOuat.....51
Viaduct Electric Co.....57
Victor Electric Co.....61
Vitro-Chrome Chemical Co.....
Vose, Ralph.....
Vulcanized Fibre Co.....27

Wagner Electric Mfg. Co.....15
Walsh's Sons & Co.....51
Want and For Sale Ads.....48-52
Ward Leonard Electric Co.....7
Warren Elec. Mfg. Co.....59
Warren-Medbury Co.....58
Watkins, F. M.....68
Watson-Stillman Co.....66
Webster Chemical Co.....25
Wennstrom Co., The John.....47
Western Electrical Supply Co.....
Western Electric Co.....5
Westinghouse, Church, Kerr & Co.....71
Westinghouse Electric & Mfg. Co.....71
Westinghouse Machine Co.....71
Weston Electrical Instrument Co.....72
Wheeler Reflector Co.....22
White & Co., J. G.....53
White Co., The O. C.....
Whitney Electrical Inst. Co.....21
Williamsport Wooden Pipe Co.....17
Willyoung, Elmer G.....4
Wirt Co., Charles.....11
Woodward Governor Co.....
Worstall & Co., A. M.....53
Wrought Iron Bridge Co.....27
Wyckoff Creosoting Co.....30

York Mfg. Co.....28
Young Mfg. Co., W. C.....69

Zimdars & Hunt.....
Ziegler Electric Co.....3

WE MANUFACTURE ARC LAMPS FOR ALL CIRCUITS.

THE ADAMS-BAGNALL ELECTRIC CO.,
CLEVELAND.

Agencies:
C. W. Phipps, No. 222 Havemeyer Bldg., New York City.
Western Electrical Supply Co., St. Louis, Mo.
Doubleday-Hill Electric Co., No. 535 Wood St., Pittsburg, Pa.
J. G. Pomeroy, No. 317 Dearborn St., Chicago, Ill.
V. A. Moore & Co., Atlanta, Ga.

SEND FOR
Catalogue B on Type K Lighting Transformers.
Bulletin No. 1 on the above apparatus.
Bulletin No. 2 on Suburban Extension Transformers.
Bulletin No. 3 on High Tension Transformers for Power Transmission.

Write to our nearest agency—
THE WESTERN ELEC. CO., New York.
RUMSEY ELEC. MFRS. CO., Phila., Pa.
M. P. WOLFE ELEC. CO., Dallas, Texas.
JOSHUA HENDY MACH. WORKS, San Francisco.

The Pittsburgh Transformer Co.,
PITTSBURGH, PA.